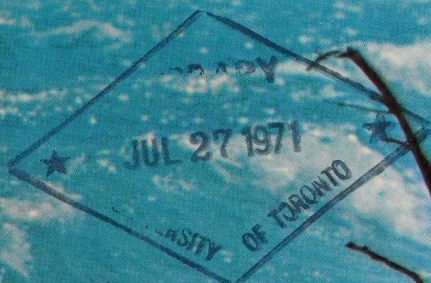


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Ontario Water
Resources Commission

1970 Annual Report



Water management in Ontario



ONTARIO WATER RESOURCES COMMISSION
OFFICE OF THE GENERAL MANAGER



WATER RESOURCES COMMISSION
135 St. Clair Avenue West
Toronto 7, Ontario

April 1, 1971

Mr. D. J. Collins,
Chairman,
Ontario Water Resources Commission,
135 St. Clair Avenue West,
Toronto 7, Ontario.

Dear Mr. Collins:

It is with pleasure that I present to you and the other members of the Ontario Water Resources Commission the Fifteenth Annual Report of the Commission.

Yours truly,

D. J. Collins
General Manager.

April 1, 1971

To: The Honourable G. A. Kerr,
Minister of Energy and Resources
Management.

Sir:

In conformity with and under the provisions of the Ontario Water Resources Commission Act, I have the honour to present to you the Fifteenth Annual Report of the Ontario Water Resources Commission.

Respectfully submitted,

G. A. Kerr
Chairman.



Ontario Water Resources Commission

1970 Annual Report Contents

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D. J. Collins *Chairman*
J. H. H. Root *Vice-Chairman*

Commissioners
H. E. Brown
F. S. Hollingsworth
Dr. C. A. Martin
D. A. Moodie
L. E. Venchiarutti
W. A. MacDonnell

Commission Secretary
M. Weissengruber
Assistant to the Chairman

STAFF ORGANIZATION AS OF DECEMBER 31, 1970

General Manager D. S. Caverly
Assistant General Managers K. H. Sharpe,
F. A. Voegelé, A. K. Watt
General Counsel H. Landis
Assistant to the General Manager
M. J. Cathcart

ADMINISTRATIVE BRANCHES

Legal: Senior Solicitor J. P. Erichsen-Brown
Personnel: Director J. C. Arber
Public Relations and Information: Director
M. F. Cheetham

DIVISION OF ADMINISTRATIVE SERVICES

L. M. Tobias *Director*

DIVISION OF CONSTRUCTION

J. C. F. MacDonald *Acting Director*

DIVISION OF FINANCE

E. F. Heath *Comptroller and Director*
J. C. McTeague *Assistant Director*

DIVISION OF INDUSTRIAL WASTES

D. P. Caplice *Director*
H. A. Clarke *Assistant Director*

DIVISION OF LABORATORIES

J. H. Neil *Director*

DIVISION OF PLANT OPERATIONS

D. A. McTavish *Director*
C. W. Perry *Assistant Director*

DIVISION OF PROJECT DEVELOPMENT

P. G. Cockburn *Director*
L. F. Pitura *Assistant Director*

DIVISION OF RESEARCH

A. J. Harris *Director*

DIVISION OF SANITARY ENGINEERING

J. R. Barr *Director*
G. R. Trewin *Assistant Director*

DIVISION OF WATER RESOURCES

K. E. Symons *Director*
D. N. Jeffs *Assistant Director*

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Introduction

The influence of man upon nature and on the world around him has increased continuously over the years. It has reached a new peak in the past decade. The extensive use of natural resources, large-scale industrial production, and increasing population and urbanization have meant that new emphasis must be placed upon ensuring a safe environment. On this vitally important condition all human activity depends.

The ever-increasing importance of our water resources — the need to guarantee the availability of adequate water supplies and to prevent the harmful effects of pollution — has led to effective measures being taken in the Province of Ontario for the protection of the aquatic environment. To this end, the Ontario Water Resources Commission has directed its efforts in 1970. Contained in this Annual Report is an outline of its activities during the past year, some of which have been highlighted in this introduction.

During the year the Government appointed two new members to the Commission — Dr. C. A. Martin of Milton, a physician and vice-president of the Halton and Peel Trust Company, and Mr. F. S. Hollingsworth, President of the Soo Mill and Lumber Company Limited of Sault Ste. Marie. The Commission is now composed of the following seven members:

Mr. D. J. Collins — Chairman
Mr. J. H. Root — Vice-Chairman
Mr. H. E. Brown — Member
Mr. F. S. Hollingsworth — Member
Dr. C. A. Martin — Member
Mr. D. A. Moodie — Member
Mr. L. E. Venchiarutti — Member

The Commission is responsible for the implementation of government policy in the financing, construction and operation of sewage and water works on behalf of municipalities and has specific powers conferred upon it by the Legislature in relation to design

approval and also to determine the public interest in specific areas of enforcement, either absolutely or subject to the approval of the Minister. During 1970, the OWRC Act was significantly revised. Included in the amendments was the authorization to increase to eleven the number of persons which may be appointed to the Commission. Due to the extremely heavy agenda faced by the Commission in recent years, it now meets at least once a week, the year round.

During the past year, several events have reinforced the importance of the OWRC's continuing liaison with other levels of government. The Federal Canada Water Act was passed and will become the major mechanism for joint efforts in inter-provincial and international water management programs. The Federal Fisheries Act was also revised, its major focus being the power to create, by regulations, national effluent standards for all industries which discharge wastes into waters inhabited by fish. The Federal Government has indicated that this latter Act will be the major anti-pollution legislation which it has at its disposal. In the spirit of co-operative federalism the Federal Department of Fisheries and Forestry asked the OWRC to work with it in developing regulations for the pulp and paper industry as well as other industries which continue to be the major sources of industrial pollution in Canada. The OWRC was able to offer its considerable experience in dealing with the pulp and paper industry.

These federal Acts, combined with the major anti-pollution thrust resulting from the IJC report on the Lower Great Lakes, has resulted in a close liaison with the senior levels of government in Canada and with state and federal jurisdictions in the United States. It is recognized that only by such close, long-term co-operation can major inter-jurisdictional pollution problems be effectively combated.

In order to ensure adequate water supplies and effective pollution control the Commission is authorized to issue technical or administrative orders based on the evaluation of the technical or scientific factors involved. These orders carry with them potential liability to prosecution in the event of default in carrying them out. In keeping with the recommendations of the Royal Commission on Civil Rights, the OWRC revised its procedures so as to afford, to those affected by such orders, the opportunity to comment in advance on the proposed action, particularly in the case of reports to municipal clerks concerning water or sewage works, and in the case of requirements and directions to industry concerning sewage works. It is recognized that whatever the Commission may order must be reasonable. Internal organization of industrial controls and processes, seasonal factors, engineering requirements, and sensible timing in staged programs are all relevant to effective use of technical orders. The municipalities and industries which have been involved in the new hearing procedures have welcomed the opportunity to comment on these matters, and substantial co-operation has resulted. It is significant that, while many technical orders have been issued, the Commission has not yet had to resort to prosecution for failure to carry them out.

More and more attention is placed by the Commission on area servicing schemes and, in these cases, local involvement is encouraged and is, in fact, required. Section 46a of the Act empowers the Commission to designate a common area for servicing for sewage and/or water. The purpose of this Section is to allow the OWRC to take action that is in the best interest of the public. To date, this Section has been used in the Sarnia, Belleville-Trenton and Blenheim areas. Before designating an area and before establishing a rate system for the local municipality, the

Commission is required to hold public hearings. Appeals with respect to both the area designated and the proposed rates can be lodged with the Cabinet. Once the area is designated, local advisory boards are established and these, in fact, make many of the detailed decisions concerning the project, as they affect the local governments. An OWRC Commissioner is usually appointed as a non-voting Chairman of the local Advisory Committee and experience, to date, has shown that local involvement can overcome many procedural problems created by the designation of a common area.

The Commission continued its policy of holding hearings, also, where pollution control sites are proposed to serve either municipalities or industries. Such hearings provide local individuals and groups with the opportunity to comment on any matters of concern to them pertaining to such installations. With the establishment of regional governments, more and more attention is being given to such local involvement. Formal committees composed of representatives of the regional governments and the OWRC are set up to establish policy and technical liaison. One such committee was established during the year with the Regional Municipality of Niagara and preliminary discussions on the formation of a similar committee for the Regional Municipality of Ottawa-Carleton were carried on towards the end of the year. The OWRC was also involved in detailed discussions with the regional governments being formed in the Muskoka and York Centre areas concerning general servicing requirements. Since each regional government has its own individual form and its own unique problems, an individual approach is taken in each instance. In addition, the financial and technical expertise of the OWRC is made available to the regional governments when requests for any such assistance are received.

Since the OWRC must acquire properties for its servicing programs, expropriation procedures, in some cases, are required. Because expropriation is another area of policy which affects local individuals and groups, the OWRC has created a Property Committee under the Chairmanship of one of the Commissioners. This Committee reviews, in detail, matters of property acquisition and recommends appropriate action to the Commission. Since, under the Expropriations Act, 1968-69, the consent of the Minister of Energy and Resources Management is required on all expropriations, a close liaison is maintained with that office.

In the spring of 1970, the presence of mercury residues in certain species of fish in Lake St. Clair led to the awareness of widespread mercury pollution in various areas of the Province. Extensive sampling of water and sediments for mercury contamination was carried out throughout the Province. Two principal industrial sources of mercury, resulting in a direct discharge to natural water-course in Ontario, were identified. These were the caustic soda and chlorine manufacturing (chlor-alkali) plants using mercury cell electrolytic processes and pulp and paper mills using organomercury compounds for slime control in processing equipment. As a result of prompt action by the Commission through the issuing of Orders to the six chlor-alkali plants the mercury losses to the water environment were virtually eliminated. The use of mercurial slimicide in the pulp and paper industry has now been discontinued.

In its drainage basin studies and analysis of the response of ecosystems to wastes, several major programs were carried forward by the Commission during the year. Of particular significance were the studies being undertaken on the Grand and the Ottawa rivers. The Grand River Basin study, commenced in 1967, has culminated in the preparation of an interim report. Due to be pub-

lished in January 1971, the report reviews the water quality problems of the drainage system, with particular attention being focused on nutrient enrichment and the response of the river to treated wastewater loadings, especially in the major urbanized areas. The report on the Ottawa River Basin study, initiated late in 1967, in conjunction with the Quebec Water Board is under preparation and is also scheduled for publication in 1971. The report includes proposed water quality standards for the Ottawa River as well as a water quality control plan outlining recommended solutions for the restoration and maintenance of water quality.

In implementing the new Guidelines and Criteria for Water Quality Management, the Commission proposes to hold hearings on river basins in various parts of the Province where there may be disagreements over water uses.

New emphasis is being placed upon the prevention of pollution resulting from spills of oil and hazardous materials. In July, the Commission, in consultation with other agencies, published the Lake Erie Contingency Plan outlining a system for the notification, containment and clean-up of spills in Lake Erie resulting from the transportation, storage and other handling of oil and hazardous material. A contingency plan for the whole of the Province was subsequently drafted and submitted for the review of those agencies and organizations which, along with the OWRC, will provide the resources necessary to ensure the effective operation of the plan. An Ontario Operations Centre has been set up within the Commission to co-ordinate the notification and the prompt response which must be undertaken following the discovery of such a spill.

Great Lakes pollution problems continued to receive close attention. During the summer, the Canada-U.S. Working Group on Great Lakes Pollu-

tion was established in order to further the implementation of the recommendations contained in the reports of the International Joint Commission on pollution in the Lower Great Lakes and the international section of the St. Lawrence River. Subsequently, ten subgroups, with the OWRC being represented on all ten, were set up to consider the major co-operative arrangements which might be made between the two federal governments, and the governments of Ontario and the Great Lakes states for more effective water pollution control in the Great Lakes region.

As a result of the recommendations contained in the International Joint Commission report that the phosphorus input to the Lower Great Lakes System be reduced to the lowest practical level, the Commission formulated a municipal phosphorus removal policy encompassing not only the Lower Great Lakes but also recreational and other areas of the Province where algae control is a critical requirement. Research studies on various aspects of phosphorus removal at municipal sewage treatment plants have been undertaken with significant successes. In order to obtain information which would assist in the design of full-scale nutrient removal facilities, pilot plants were installed at several locations. Having successfully demonstrated the feasibility of combining chemical treatment with conventional biological process facilities with a view to providing phosphorus removal from domestic sewage, the Commission undertook the construction and operation of a full-scale installation at a municipal plant as a demonstration and further research facility. The construction of this system was nearing completion by the end of the year and will come into operation in January of 1971.

The development of provincially-owned water and sewage projects under Section 16 of the Act continued at an

increasing rate in 1970. The Government's policy, introduced in 1969, of providing financial assistance in the case of high-cost facilities has increased the number of municipalities requesting the OWRC to provide required works. Fifty-six programs were accepted by the Commission during 1970, for a cumulative total of 318 since this provincial ownership plan was introduced in 1964.

The South Peel Regional System, one of the earliest projects undertaken on the basis of provincial ownership, completed its first full year of operation in 1970. The project is the largest provincially-financed system undertaken to date for the supply and distribution of water and the collection and treatment of sewage and will take a number of years to complete. Five municipalities, with a population exceeding 200,000 receive services from this system. Local distribution and collection facilities are provided and owned by the individual participating municipalities. During 1970, a large expansion of water distribution mains and trunk sewers was initiated. A tight construction schedule is maintained in order to meet the requirements of this rapidly developing area.

Early in 1970, arrangements were made between the Province of Ontario and the Federal Government whereby responsibility for the approving of individual applications for Central Mortgage and Housing Corporation loans for sewage works was assumed by the Province and implemented by the OWRC. Priorities are established on a first-come, first-served basis with consideration being given to the effectiveness of the proposed works in reducing pollution. The \$25 million allocation for the Province of Ontario was fully utilized by early November. OWRC projects accounted for approximately \$15.7 million of the total, with municipal projects accounting for the balance.

Early in 1970, meetings were held with the Steel Company of Canada Limited and with Ontario Hydro concerning

the possibility of the OWRC having a share in the water intake facilities being constructed by Ontario Hydro to serve its generating station at Nanticoke. Preliminary engineering was undertaken to determine what facilities would be required by the OWRC if the Ontario Hydro intake was to be used as a source of water, not only for the potential industrial use, including that of the steel mill, but also for the municipalities in the Grand River Valley region. Meetings were also held with Texaco Canada Limited in view of that firm's plans for locating in the Nanticoke area as well.

Because of the critical timing schedule concerning the Hydro intake facilities, approval was obtained by the OWRC from the Treasury Board to participate in an oversized intake facility with Ontario Hydro to ensure that the economic advantage of such a shared facility could be realized in the future, if and when water was to be supplied to some of the municipalities in the area. At the end of the year, discussions were continuing with Ontario Hydro to formalize the arrangements for the construction of the oversized facilities. In addition, the Commission continued to participate with other Government departments in planning for the future water requirements of the Grand River watershed.

Administrative Branches

OWRC Head Office, Toronto



Legal Branch

J. P. Erichsen-Brown,
Senior Solicitor.

The legal services of the Commission were reorganized at the beginning of the year. This reorganization was accompanied by an expansion of staff that coincided with a stepped-up program of prosecutions and other enforcement measures authorized by The OWRC Act. Following the reorganization, the Legal Branch continued to have responsibility for general legal services, with emphasis on contracts and litigation, including:

- (1) the legal enforcement of prohibitions of the Act by prosecutions, civil litigation, arbitrations and the preparation of technical orders with potential legal sanctions;
- (2) advising on and drafting contracts incidental to the financing, construction and operation of sewage and water works, together with policy aspects of property acquisitions in project development;
- (3) negotiation and settlement of claims arising out of construction contracts under The Public Works Creditors Payment Act;
- (4) acting as prosecuting counsel at the trial of cases not handled by Crown Attorneys.

PROSECUTIONS

Twenty-six companies, one municipality and two individuals were convicted in 1970 on a total of 38 charges of impairment of water under Section 27(1) of the Act. The maximum fine of \$1,000 on individual counts was imposed eight times. There were no prosecutions for infractions after November 13th when the 1970 amendment to the Act came into force. Accordingly, there was no occasion for the imposition of the increased fine now possible under that amendment. One municipality was convicted for constructing sewage and water works without approval. There were several convictions for breaches of the well-drilling, plumbing and boating regulations.

Personnel Branch

J. C. Arber, Director

MANDATORY ORDERS

Requirements and Directions were issued under Section 50 to 18 corporations during the year. Several of these called for reports and construction in staged programs extending over several years. Eleven were issued, simultaneously, calling for immediate action in relation to mercury pollution. These included six chlor-alkali companies using mercury in process, and five pulp and paper companies using mercury fungicide. There was compliance, generally, with all orders issued by the Commission and no prosecutions were necessary because of default.

Formal reports were issued to the City of Sudbury and the Regional Municipality of Ottawa-Carleton during the year under Section 38 of the Act in regard to the provision or enlargement of sewage treatment facilities.

During the year, in compliance with recommendations of the Royal Commission on Civil Rights, the Commission adopted the practice of inviting municipalities and companies to appear before the Commission to make such representations as they might desire concerning the text, scope or modification of a proposed mandatory order, prior to its being issued.

This new practice involved an increase in work for the Legal Branch, as did also a number of other changes in legal requirements, such as the new Expropriations Act. The Branch was also involved in problems relating to regional municipal organization and unorganized territories.

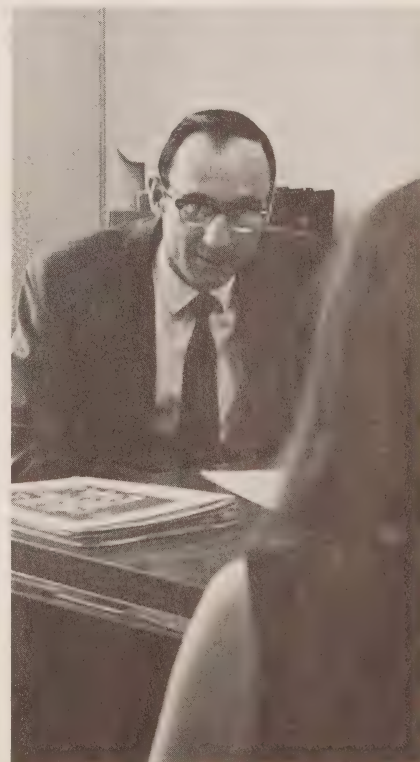
The Commission's recruitment program was somewhat changed from previous years. The hiring of new employees, usually concentrated upon in the spring and early summer, was spread throughout the year. Liaison was maintained with universities and community colleges through on-campus interviews and the distribution of information for graduating students. There were 181 full-time employees recruited for Head Office, and 35 for sewage and water treatment plants. Terminations totalled 114 in the former, and four at the latter.

The number of applications for summer work from students was even greater than in 1969. At the peak point in the summer, there were 138 students on staff employed in field programs and laboratories. Participation in the University of Waterloo Co-operative Program resulted in a total of 36 students being employed in 1970. Of these, 31 worked for one 4-month term, and five for two 4-month terms. Two professional employees returned to university for graduate studies, supported by bursaries. Sixty-two members of staff were provided with financial assistance to attend extension courses at universities, community colleges, and secondary schools throughout the Province. There was also continued participation in courses conducted by the Staff Development and Research Branch of the Department of Civil Service.

Increased attention was given to the classification program. At the year end, priorities had been established for the completion of the several phases of the program. The Memorandum of Understanding with The Civil Service Association of Ontario, Inc., concerning employees in the bargaining unit of the Division of Plant Operations, expired December 31, 1970. Preliminary negotiations with respect to a new agreement were underway by that date.

On December 31, 1970, the staff of the Commission was distributed as follows:

Head Office Organization	
Permanent and temporary	788
Seasonal casual	86
Provincial Works	
Permanent and temporary	127
Regular part-time	6
Casual	11
Plant Operations	
Permanent and temporary	215
Regular part-time	14
Casual	24



Public Relations and Information

M. F. Cheetham, Director

Public awareness of pollution reached a peak during 1970. At no previous time has there been a greater concern for the environment among the citizens of the Province of Ontario. An independent research study, undertaken during the year to gauge the public's attitude, placed water and air pollution as the most important problem of concern to people today — exceeding their concern even for inflation.

This acceleration in the development of public awareness was the result of a number of factors. News media throughout the Province devoted more space and time to the subject of pollution than in any previous year. Feature writers and commentators undertook in-depth studies on pollution and urged readers, listeners and viewers to become concerned. Citizen groups formed and spearheaded local action programs. Elected representatives displayed an increased interest and, generally, the whole attitude of the community at large changed significantly from an apathetic one to one of commitment to an improved environment.

To keep pace with this expanded communications activity and public interest in pollution abatement, all programs in Public Relations and Information were accelerated during the year. Particular emphasis was placed on print production, news media servicing, educational programs and similar mass communication areas. A phenomenal increase was experienced in the request for resource materials from students and teachers at all school levels in the Ontario educational system.

In order to meet its responsibilities for the development of an internal/external educational and informational program, designed to create an awareness of water management and pollution control in Ontario, PR&I activities are divided into four areas of operation: editorial, audio-visual, exhibits and education, and special events. Ancillary services include advertising, public rela-

tions counsel, project promotion and opinion research.

EDITORIAL

In its responsibility for the preparation and distribution of news releases, feature articles, news media liaison and internal/external communications programs, the Editorial Section of PR&I issued 58 news releases during the year, 18 on municipal water and sewage programs, 24 on industrial waste treatment programs, 12 on topical water management developments and four on miscellaneous Commission announcements.

Basic background information and illustrative photographic material were also developed for twelve feature articles on pollution and on activities of the Commission, and supplied to major metropolitan daily newspapers, local and national television networks, and urban radio stations. Local OWRC activities were researched and summaries prepared for local members of parliament and for the government and opposition caucus offices.

The Commission's bi-monthly tabloid newspaper "Watertalk", which is directed to those interested in the many facets of water management, was issued six times during the year with a total distribution of 42,000 copies. The six issues contained approximately 150 news and feature articles on OWRC and other water management subjects, several of which were reproduced verbatim in weekly newspapers throughout the Province and sparked ideas for feature articles in the professional press. All OWRC employees received copies of "Watertalk". In addition, two issues of the internal employee "OWRC News" were produced and distributed to staff.

AUDIO-VISUAL

Services of the Audio-Visual Section of PR&I include the recording of all noteworthy activities of the Commission in black and white and colour still

photographs, colour slides, motion picture and parallel communication aids. The photographs are used continually to illustrate the programs of the Commission. They are distributed to news media at their request, and are incorporated in the numerous pamphlets, brochures, reports and resource publications produced by the Commission in its overall educational and informational programs.

Nearly 2,000 black and white and 700 colour pictures were taken by Commission photographers during the year. Three thousand black and white prints and 1,100 colour slides were reproduced. Four TV public service news clips were produced and distributed to the television stations throughout the Province. The clips, based on a "clean water" theme, highlighted the activities of the Commission on a seasonal basis and were used repeatedly by the stations throughout the year. Altogether, 122 prints of the clips were produced for this visual information program. In addition, nearly 1,500 feet of motion picture film was shot to provide visual footage for the TV clips, document Commission activities, up-date the stock film library, and provide stock footage for requests for background film from television stations and networks, and educational television film producers.

Slide reproduction of charts, graphs and illustrative material for the presentation of papers, reports and speeches by Commission personnel significantly increased during 1970. Thirteen of these special assignments were undertaken and included the development and duplication of a 40-slide series for the Commission's exhibit at the annual Boat Show in Toronto; the masking, copying and assembly of slides of graphs and charts for the delivery of a paper on the OWRC silicate process for curbing iron problems in municipal water supplies and for a paper on the study of the nutrient environment of phytoplankton in the Bay of Quinte; and the assembly

of a slide series which is available through PR&I as an educational aid to schools. The latter series covers the activities of the Commission, the operation of water and sewage treatment plants and water pollution. Each set consists of 10 to 20 individual slides.

Activity in the film library doubled during the year with 701 bookings being recorded, resulting in over 1,200 showings. An estimated 58,594 viewers were exposed to OWRC films, nearly double the audience reported in the 1969 annual report. For the last two months of the year, bookings were handled by a commercial distribution house, Modern Talking Picture Service, resulting in 103 bookings, 208 showings and 8,168 viewers. During the summer months, this agency also provided a film service in resort areas for the Commission and distributed the Commission's film "The Choice Is Yours" as part of an evening entertainment package. The film was booked 31 times, and was viewed by 3,000 people of all ages. Commission films were also shown on three TV stations in the Province, with an estimated viewing audience of 75,000.

EXHIBITS

The regular exhibits program continued throughout the year, with the Commission's participation in fairs being increased. The Commission's permanent display in the government building concourse at Niagara Falls continued. Exhibits were installed at several conferences, including the Water Well Drillers Conference, the Canadian Education Showplace, the Boat Show and the Ontario Health Inspectors Annual Conference in Sudbury.

Major OWRC displays were on view in Thunder Bay, Ottawa, London, Peterborough, Leamington, Gravenhurst, Napanee, Woodstock, Oakville, Chatham, Sutton, Burlington, and Welland. Two travelling exhibits were on the road during the summer months, manned by

university student summer help. The latter program resulted in the distribution to the general public of over 200,000 pieces of literature, book-covers, lapel stickers and buttons, all with a "clean water" theme.

EDUCATION

The provision of educational resource material on water management and pollution control to Ontario's primary and secondary schools increased phenomenally in 1970. PR&I staff members were involved in over 100 individual presentations and seminars with students and teachers, as well as providing audio-visual material, films and literature for class resource projects.

In order to accommodate the increased interest at the student and teacher level, PR&I developed a resource kit program for school resource and reference libraries. The kits, with companion teacher kits, are structured to meet the needs of students at the Grades 1 to 9 and 10 to 13 levels, and are supplied in class sets of 35 to school libraries on request from the teacher or the librarian.

Student Education



In one three-month period, largely as a result of a single item in a Metropolitan Toronto daily newspaper, PR&I received and accommodated requests from nearly 1,100 Ontario schools for this resource material. This resulted in the packaging and mailing of 37,500 kits, involving the assembly of 182,804 individual pieces of literature. Casual staff had to be engaged to keep up with the demand for the resource material.

Personal services to the general public reached an all-time high in 1970. Office personnel in PR&I handled more mail, visitors and phone calls than ever before. An estimated 4,000 people visited the PR&I offices, 24,000 pieces of mail were received and over 8,000 telephone calls handled. As a result of this activity, over 444,000 pieces of literature were distributed.

An indication of the increasing interest of the public in pollution can be seen in a comparison of literature distribution figures over the past few years. In 1967 an estimated 300,000 pieces were circulated; in 1968 this rose to 478,000 and in 1969 to 700,000. The total number of pieces of literature distributed by the Commission in 1970 was 878,000.

SPECIAL EVENTS

Plant openings, public hearings, conferences and meetings and public speaking engagements also occupied considerable time of PR&I staff.

Five official plant opening ceremonies were held in 1970, with PR&I being responsible for the development and execution of the associated programs. These openings were at Red Lake, Haileybury, Stayner, Prescott and Chesterville. Public hearings were held in Belleville, Kitchener and Blenheim, with PR&I being responsible for news media liaison, photo coverage, publicity, and installation and operation of the public address systems when required.

Thirty-five miscellaneous confer-

ences and meetings were attended during the year, and 125 public speaking engagements were undertaken. The latter included addresses to service clubs, church and women's groups, schools, teacher seminars and similar public meetings.

ANCILLARY SERVICES

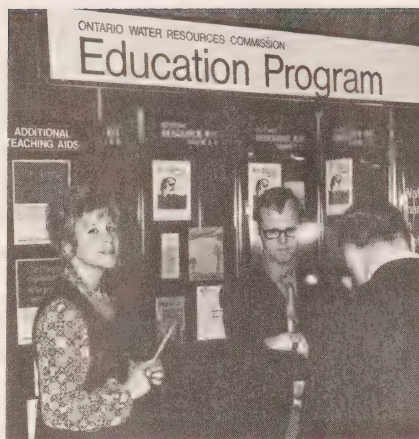
The Commission's advertising programs during the year were confined to specific areas, such as the promotion of the Ontario Boating Regulation, the "clean water" theme and the recreational lakes pollution abatement program.

An advertisement on the Boating Regulation, including a listing of the location of marina pump-out stations throughout the Province, was produced and run in 11 daily newspapers and four boating publications. Two other advertisements on the same regulation, as well as an advertisement on overall Commission services and objectives, were produced and inserted in various vertical business publications.

Billboard advertising in the recreational lakes areas was introduced in 1970. The general theme of the message was "It's your water . . . keep it clean", superimposed on a photograph of a young boy knee-deep in water. These billboards were on view at 101 locations throughout the Province — specifically, along the access roads to the Province's recreational lake areas.

Supporting this program was a paid radio spot series which was aired on summer week-ends over key stations serving the highway arteries into the recreational lake areas, and reminding listeners of their role in improving the environment. Nineteen radio stations were used in this campaign, many of which utilized the spot series in a continuing public service program.

In addition to the public service TV news clips already mentioned, PR&I also produced public service radio spot



Educational Resources Display

scripts on the recreational lake pollution problem and circulated these to all radio stations in Ontario. Reaction to these was good, with many of the stations using them continually during the summer months. So successful was the series, that a similar series, highlighting the problems encountered with snowmobilers and ice fishermen, was produced and circulated for the winter months.

Because of an independent public attitude survey concerning pollution, undertaken by Market Facts of Canada, no formal opinion research study was undertaken by PR&I in 1970, as had been done in previous years. The results of this independent survey, which paralleled those revealed in the Commission's surveys of the past two years, showed a progressive awareness of the problem, and were used as a guideline for the development of public education and information programs.

The Commission again sponsored the Ontario Weekly Newspaper Association editorial contest for the best editorial on water resources. Entries are judged by the OWINA's awards committee, with the winning editorial in 1970

being produced by the Tilbury Times. An appropriate award is presented to the winning editorial writer at the Association's annual meeting.

GENERAL

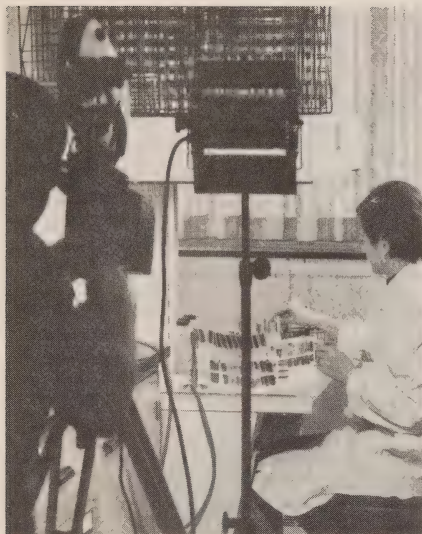
In addition to the specific areas of operation referred to above, PR&I personnel are also involved in a consultative capacity, as well as an assistance program, to various agencies and associations whose programs and activities are related to those of the Commission. During the year specific assignments were undertaken on behalf of the Ontario Branch, Canadian Institute on Pollution Control, the Great Lakes Environmental Conference, the Lake Erie Legislative Committee, the OWRC Industrial Wastes Conference, the Ontario Government Committee on Communications, the Department of Education's Educational Television Branch, and the national directorate of the Canadian Public Relations Society. PR&I was also responsible for co-ordinating the Commission's participation in Survival Day, a one-day seminar held at community colleges throughout the Province in co-operation with the Ontario Federation of Labour, and also the summer recreational lake education program undertaken by University of Toronto Pollution Probe personnel.

The public relations officer for the Water and Sewerage Authority of Trinidad and Tobago was attached to the PR&I office for five months during 1970. Sponsored by the Pan-American Health Organization, the officer understudied the public relations and communications program being conducted by the Commission with a view to applying the techniques used to his own program at home.

The placement of all advertisements relating to public hearings, tender calls and any other print notices respecting the operations of the Commission is the responsibility of PR&I. In addition, it is

Division of Administrative Services

L. M. Tobias, Director.



Film Production

responsible for the overseeing of the editorial content, format and design of all Commission informational literature, displays, films and similar communication vehicles.

1970 was a most active year with all PR&I personnel working to their full capacity. The statistics indicate that it was the most productive year to date. There is no indication of any lessening in the demand for pollution information in the ensuing twelve months. Staff and program expansion is necessary, therefore, if the Commission is to keep pace with the citizen demand for a cleaner environment.

The Division of Administrative Services is responsible for buildings management matters related to the two main offices and the Laboratory in Toronto, as well as the regional offices and facilities at Kingston, London, Thunder Bay and Sault Ste. Marie, and the district offices at Galt, Peterborough, Sarnia, and Sudbury. The Division is also responsible for systems design and computer programming and operation; the purchasing, storage and inventory control of goods and services; the maintaining of files and records and the administration of the Commission's records management program.

Renovations were completed in the additional rented space obtained at Kingston in connection with the expansion of the Kingston Regional Office. Rented space was also obtained to accommodate staff in newly-established district offices in Galt, Peterborough and Sarnia. The Sault Ste. Marie Regional Office and Laboratory were established during 1970 in the old police building obtained for the use of the Commission by the Department of Public Works.

Due to the critical shortage of space at the Commission's Toronto Laboratory where the Division of Research has been accommodated, separate accommodation was approved by Treasury Board involving the relocation of that Division to a two-storey building on Chesswood Drive in North York. Treasury Board approval included the rental of space, renovations, partitions, essential services, and laboratory benching.

Approval was also received from Treasury Board to complete the preparation of working drawings and specifications for the Toronto Laboratory expansion. Numerous meetings and discussions were held with the Department of Public Works representatives, the Division of Laboratories, and the associate architect with a view to completing the drawings in the early part of 1971.

Treasury Board approval was also received for the consolidation of the OWRC Regional Office and Laboratory in London. Meetings were held with the representatives of the Department of Public Works to supply them with information concerning the Commission's requirements in connection with the new building to be constructed in 1971.

The 17th Ontario Industrial Waste Conference held in Niagara Falls, Ontario, in June was highly successful. This conference, dealing with the problems of industrial waste, attracted over 350 senior officials representing the three levels of government, consulting engineers, manufacturing industries, equipment suppliers, universities, and others. The delegates came from all provinces of Canada, and from the United States.

During 1970, a number of meetings were held with the Department of Public Works' horticulturalist concerning plans to landscape and make improvements to the Head Office property at 135 St. Clair Avenue West. Arrangements were made for the installation of two flagpoles and a reflecting pool, and also for appropriate planting to be done.

Assistance was given to the Division of Plant Operations in the renting of a small office building and storage area in Mississauga in connection with the South Peel County Area project.

The Division initiated the development of an information system which will provide statistics on consultants' and contractors' fees, construction costs, and similar data for the use of senior management.

During 1970, retention and disposal schedules were established for 1,500 cubic feet of records stored at Cooksville. There is now a total of 2,039 cubic feet of records maintained at that location. As of December 31st, 1970, there were 35 retention and disposal schedules established for Commission records at Head Office and 16 schedules were nearing completion. The scheduling of all records in the Central Records

Branch has resulted in the saving of 600 square feet of floor space.

A more detailed account of the activities of each of the three branches which make up the Division — Systems and EDP, Central Records and Purchasing — follows.

SYSTEMS AND EDP BRANCH

The overall objective of the Systems and EDP Branch is to provide the systems analysis, design, programming and electronic data processing services required by the Commission.

The Branch comprises three sections: Systems and Programming, Data Control, and Key punch. The Systems and Programming Section is responsible for the analysis, evaluation, design, programming and implementation of system changes as warranted. The Data Control Section is responsible for the editing, processing, and control of source data and program execution. The Key punch Section is responsible for the conversion of source data into machine-readable input.

The bulk of computer processing is executed on the IBM System 360 Model 65 installation located at the offices of the Ontario Department of Highways. Computer terminal facilities are currently being investigated to enable program testing and the processing of data at the Department of Highways' computer by means of telephone lines.

Some of the projects undertaken by the Branch during 1970 are described below:

The design of a Water Quality Information System was completed in early 1970. The major objectives of the system are to improve the significance, flexibility, accuracy, response and economy of water quality data reporting. The writing and testing of the programs to process the water quality data gathered from survey work on the Great Lakes is now underway.

A study concerning the gathering, processing and reporting of laboratory

data was completed. The alternative methods proposed for handling these processes are now under review.

The storage segment of a system to process water well data was designed and implemented during 1970. Drilling information dating back to 1947 was coded, keypunched and processed to create an edited magnetic tape master file. On completion of the conversion to magnetic tape storage, data pertaining to 150,000 water well drill logs will be available for retrieval. The first retrieval programs now being written will be used in the production of Ground Water Bulletins.

A digitizing system was implemented utilizing equipment at the Department of Highways and a program developed by the Canadian Federal Government. The system was used to translate stream gauge chart readings to meaningful water flow information.

The storage and retrieval segments of both the Current Meter and Water Quality Meter systems were implemented. This information was then used as input to mathematical models employed in predicting the effects of local currents and water movements on proposed plant intakes and outfalls. These models were used for sites on Lake Ontario and Lake Erie for projects involving the divisions of Industrial Wastes, Project Development, and Sanitary Engineering.

A new Project Development Rate Calculation Program to accommodate changes in financing policy was developed and implemented in the first quarter of 1970. The program calculates the service rate per 1,000 gallons of treated water or sewage, and, if the rate is excessive, it determines the amount of aid the project may be eligible for under the Provincial Assistance Scheme. During the year, the program was run approximately 420 times on 120 projects. In many cases a project rate was calculated a number of times to determine the effects of varying conditions.

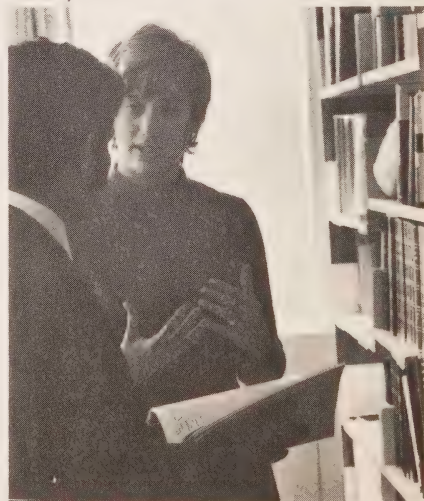
The IBM 1050 terminal was replaced with the IBM 2741 terminal. This terminal is used for entry into the CALL/360 time-sharing service to assist in the solving of engineering-research type problems, and for entry into the Alphatext Service to assist in the computer preparation and publishing of Commission reports.

The Branch participated in the development of two Systems and Data Processing courses currently being set up under the guidance of the Staff Development & Research Branch of the Department of Civil Service — the program design course and the project management course.

CENTRAL RECORDS

During 1970, there were approximately 170,000 pieces of correspondence received by Central Records for processing. Files related to the Galt area were duplicated for the Galt District Office. During 1970, 231 cubic feet of record material were separated, checked, packed and transferred to Cooksville.

Library Services



SUPPLY BRANCH

The Supply Branch is responsible for:

- (a) the purchasing and acquisition of the goods, materials and services required by the Commission at its head office and laboratory locations, as well as at its various water and sewage projects located throughout Ontario;
- (b) the storage and dispersal of office and technical supplies at the main head office and laboratory locations;
- (c) the operation of two warehouses where bulk supplies, marine equipment and other rolling stock are stored;
- (d) the supplying of regional offices and laboratories with materials necessary for their operation; and
- (e) the processing for payment of invoices from suppliers, and the control of inventory at head office and at OWRC projects.

An arrangement was made between the divisions of Administrative Services, Plant Operations and Finance whereby confirming purchase orders were eliminated for purchases of \$50.00 and less. New procedures were also implemented, through joint approval by these three divisions, as a result of which charges for utilities are paid more promptly, resulting in substantial discount savings.

The processing of petty cash charges and travelling expenses was transferred to the Division of Finance. Inventory records continued to be maintained for petty cash expenditures on equipment exceeding \$50.00.

A system of reporting vehicle operating costs was implemented for those Commission-owned vehicles purchased with Ordinary Vote funds. Vehicle log books were distributed, vehicle coordinators were appointed, a vehicle coding method was developed, and a data gathering function was set up in Inventory Control.

Increases in the total number of projects serviced by the Supply Branch in the past year, together with increases in head office personnel, resulted in considerable pressure being placed on its staff for services. Similar pressures resulted from the rapid expansion of regional and district offices at Thunder Bay, Sault Ste. Marie, Galt, Peterborough and Sarnia. Heightened activities within the divisions — for example, the mercury program within the Division of Laboratories — also resulted in an increased workload.

Purchasing

A comparison of purchasing activity for the three years — 1968, 1969 and 1970 — follows:

1968	Number of Orders	Value
Ordinary	5,564	\$ 2,555,797.56
Operating	4,329	694,945.66
Capital	537	17,033,140.41
Total	10,430	\$20,283,883.63
1969		
Ordinary	5,094	\$ 1,647,033.08
Operating	4,725	711,377.02
Capital	465	56,304,011.16
Total	10,284	\$58,663,321.26
1970		
Ordinary	5,130	\$ 1,733,623.99
Operating	3,855	921,321.60
Capital	620	93,978,658.92
Total	9,605	\$96,633,604.51

The foregoing figures reflect the continuing, rapid escalation of Capital and Operating expenditures in comparison with minor increases in administrative costs.

Early in 1970, the Inventory Control function, which had previously been combined with Invoice Verification, became a separate entity. Besides maintaining records on purchases of all equipment valued at \$50.00 or more — both on the Operating and the Ordinary Votes — Inventory Control personnel conducted physical checks at four projects, three of which were transferred from the OWRC to the Regional Government of Niagara during 1970. In addition, physical inventory checks were conducted on office equipment in six OWRC divisions.

Invoice Verification

The following table indicates the number and value of invoices processed during the year:

Operating Vote Charges	No. of Invoices	Value
— Utilities	6,276	\$1,292,686.59
— Purchase Orders	2,516	641,789.84
— Confirming Purchase Orders	1,578	386,368.18
— Contract Purchases	3,879	1,507,695.61
— Hardware Account (under \$15)	3,593	606,874.43
	17,842	4,435,414.65
Ordinary Vote Charges	7,435	2,299,389.30
Grand Total	25,277	\$6,734,803.95

Electronic Data Processing



Division of Construction

J. C. F. Macdonald,
Acting Director

Laboratory Stores

Receiving Section	1966	1967
Incoming Shipments	13,619	15,011
Incoming Packages	20,273	23,320
Incoming Samples	72,488	98,571
Total	106,380	126,902

	1968	1969	1970
Incoming Shipments	13,705	12,765	12,852
Incoming Packages	20,940	20,396	18,143
Incoming Samples	91,991	94,915	107,115
Total	125,736	128,076	138,110

Increases in the workload within the Receiving Section were occasioned by the addition of a second warehouse on Dolomite Road, increases in the numbers of regional and district offices, mobile laboratories, and crash programs such as the mercury program.

The continuation and expansion of annual and blanket-type purchase orders, together with storage of supplies

Printing Services



by vendors until required, minimized paperwork, shipments and stockouts. This resulted in a 14 percent reduction over 1969 in the number of shipments of laboratory, maintenance, and field equipment supplies handled by Receiving staff. As a result, express shipping costs were maintained at about the same level as the previous year in spite of increases in minimum freight rates.

Shipping Section

	1966	1967
Outgoing Shipments	7,272	7,518
Outgoing Packages	13,503	15,302
Outgoing Bottles	90,445	99,361
Total	111,220	122,181

	1968	1969	1970
Outgoing Shipments	5,867	5,315	4,989
Outgoing Packages	13,566	12,224	11,821
Outgoing Bottles	94,954	96,325	103,952
Total	114,387	113,864	120,762

Glassware Processing:

	1967	1968	1969	1970
Machine Loads	3,499	2,920	3,017	3,540

Small Equipment and Linen Stores:

	1966	1967	1968	1969	1970
Requisitions Filled	1,703	2,011	1,826	2,600	1,660

Mail and Messenger Service — 135 St. Clair Ave. W.

	1968	1969	1970
Outgoing Mail	199,153	232,580	230,250

Stationery Stockroom — 135 St. Clair Ave. W.

	1968	1969	1970
Requisitions	13,013	14,589	12,547

The Division of Construction is responsible for the administration of contracts let by the Commission for the construction of water works or sewage works which are being undertaken as Commission-financed projects for municipalities or groups of municipalities. This involves the overall supervision of the work carried out by consulting engineers and contractors.

During the design stage of projects, the Division is involved, together with certain other divisions, in the review of reports, proposals for equipment and plans and specifications submitted by the consulting engineers.

Project engineers of the Division make frequent on-site inspections of Commission projects which are under construction and investigate any problems which arise.

Technicians of the Division check and test equipment, both in the factory and after installation at the site, carry out testing of sewers and water mains and make photographic inspections of the interior of sewers on certain projects. During 1970, technicians of the Division carried out photographic inspections of the inside of sewers at Beeton, Township of Bucke, Cayuga, Chesherville, Township of Emo, Township of Ernestown, Harriston, Hearst, Ignace, Moonbeam, Port Colborne, Richmond and Stayner.

During 1970, laser equipment was used for the first time by contractors on Commission projects (Cayuga and Cannington) for the installation of sewers to correct line and grade. This system uses a laser beam projector which is usually set in the bottom of a manhole so that the laser beam travels along the exactly-required centre line of the sewer to be laid. Each new length of pipe laid has a special target fitted in the end and the pipe is adjusted in its bedding until the target is centred exactly on the laser beam. The contractors found that this system enabled them to lay sewers more rapidly and more accurately than by the

traditional boning rod and sight rail method.

In early November 1970, the Badger System of trenchless pipelaying was used for the first time on a Commission project (Stayner). This system employs a powerful tractor with a vertical blade to cut a narrow slit in the ground to the required depth. At the bottom of the blade is an expander which makes a tunnel into which the pipe is drawn in pre-jointed lengths of 600 ft. or so. About 3,300 lin. ft. of 8 in. diameter PVC plastic pipe was installed by this method at Stayner for use as a sewage forcemain.

During 1970 the Commission entered into 50 contracts valued at \$56,137,950 of which \$12,278,665 was for water works and \$43,859,285 was for sewage works.

Forty contracts were completed during the year. These had a total value of \$14,842,106 and consisted of 20 water works totalling \$6,072,866, 17 sewage works totalling \$6,735,665 and three contracts covering both water works and sewage works totalling \$2,033,575.

In January 1970, the Commission awarded to W. A. McDougall Ltd. of London, Ontario, a \$20,368,700 contract for the construction of extensions to the City of Hamilton's sewage treatment plant. This contract will provide secondary treatment facilities and is the largest single sewage works contract in Canada.

There was a substantial increase during 1970 in the number and total value of Commission projects under design or construction and the work load of the Division's staff increased accordingly.

A summary of the OWRC projects under construction during 1970 follows:

ARTHUR (1-0093-67)

Description of Project: Extensions to the existing sanitary sewerage system and the addition of a 7.5 acre lagoon cell.
Consulting Engineers: Philips & Roberts Ltd., Burlington.

Contract 1 — Sanitary sewers and an underground pumping station. Completed — July 1970. Final contract cost — \$407,161.83.

Contract 2 — Lagoon extension. Completed — November 1970. Final contract cost — \$45,564.06.

Estimated Final Project Cost: \$510,000.00.

BELLEVILLE (1-0004-66)

Description of Project: Extensions to the sewage works.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Contract 1 — Extension to existing sewage treatment plant to provide secondary treatment. Expected completion date — August 1971. Estimated contract cost — \$1,842,155.00. Work started on April 12, 1970 and by the end of the year was 67 percent completed.

Contract 2 — 24 in. diameter force main from the Front Street sewage pumping station to the sewage treatment plant. Completed — November 20, 1970. Estimated contract cost — \$158,391.00.

Estimated Project Cost: \$3,100,000.00.

BLEZARD VALLEY WATER SUPPLY SCHEME (5-0030-67)

Description of Project: A water supply system to provide water to the Township of Valley East, Rayside and Balfour consisting of wells, storage facilities and trunk watermains.

Consulting Engineers: Kilborn Engineering Ltd.

Contract 1 — A 300,000 Imperial gallon elevated tank and 1,200 lin. ft. of 14 in. diameter watermain. Completed — November 1970. Estimated contract cost — \$213,000.00. This tank is presently used exclusively to serve the Township of Balfour but it will become part of the Blezard Valley water supply system on completion of the trunk watermain in the coming year.

Contract 2 — Six production wells. Expected completion date — February 1971. Estimated contract cost — \$107,000.00.
Estimated Project Cost: \$16,500,000.00.

TOWNSHIP OF BUCKE (5-0051-67, 1-0094-67)

Description of Project: Sanitary sewers, pumping station, forcemains, lagoon and water distribution system.

Consulting Engineers: Sutcliffe Co., New Liskeard.

Completed: November 16, 1970.
Final Project Cost: \$635,529.00.

BRADFORD (1-0035-66)

Description of Project: A high rate treatment plant and alterations to existing pumping station.

Consulting Engineers: Proctor & Redfern Ltd., Toronto.

Expected Completion Date: June 1971.
Estimated Project Cost: \$787,000.00.

Work commenced early in October 1970 on the excavation for the blower building and aeration tanks and progressed satisfactorily despite adverse ground water conditions. An influent chamber and diversion piping to the existing lagoon were installed and work proceeded on a forcemain, gravity sewer, mechanical and electrical installations in the blower building and the foundations for the aeration tanks.



BURLINGTON (2-0241-68)

Description of Project: Extension to Skyway water pollution control plant.

Consulting Engineers: James F. MacLaren Ltd., Toronto.

Completed: May 22, 1970.

Estimated Final Project Cost: \$811,000.00.

CAMPBELLFORD (1-0028-66)

Description of Project: Trunk sanitary sewers, forcemain, pumping stations and sewage treatment plant.

Consulting Engineers: Canadian British Engineering Consultants Ltd., Don Mills.

Contract 'A' — Trunk sanitary sewers and forcemain. Completed — February 4, 1970. Final contract cost — \$139,056.00.

Contract 'B' — Sewage treatment plant. Expected completion date — February 1971. Estimated contract cost — \$853,558.00. Work at the treatment plant is approaching the start-up stage which is expected at the beginning of February 1971.

Estimated Project Cost: \$1,112,600.00.

**CANNINGTON (1-0016-66)**

Description Of Project: Sanitary Sewers, pumping station, forcemain and two-cell lagoon.

Consulting Engineers: Oliver Lloyd & Associates Ltd., Don Mills.

Expected Completion Date: October 18, 1971.

Estimated Project Cost: \$853,800.00.

Work commenced on November 2, 1970. By December 31, the contractor had installed approximately 20 percent of the street sewers.

CAYUGA (1-0043-66)

Description Of Project: Sanitary sewers, pumping station, forcemain and sewage treatment plant.

Consulting Engineers: Walter, Fedy, McCargar, Hachborn, Kitchener.

Contract 1 — Sanitary sewers. Expected completion date — February 1971. Estimated contract cost — \$533,040.00. By the end of December 1970 approximately 30,000 lin. ft. of main sewers and 6,000 lin. ft. of service connections had been completed. Approximately 1,800 lin. ft. of sewer and 5,000 lin. ft. of service connections remain to be laid.

Contract 2 — Pumping station, forcemain and sewage treatment plant. Expected completion date — January 1971. Estimated contract cost — \$228,185.30.

The factory-built pumping station was energized on December 15, 1970. The treatment plant was about a month behind schedule because of late delivery of some equipment. It is expected that the plant will be put into operation towards the middle of January 1971.

Estimated Final Project Cost: \$900,000.00.

CHESTERVILLE (1-0048-66)

Description of Project: Sanitary sewage system.

Consulting Engineers: J. L. Richards & Associates Ltd., Ottawa.

Contract 1 — Sewers, forcemain, pumping station and lagoon.

Completed — December 5, 1970.

Final contract cost — \$579,847.00.

Contract 2 — Sanitary sewer extension.

Completed — December 15, 1970.

Final contract cost — \$21,570.00.

Estimated Final Project Cost: \$690,000.00.

CORNWALL (2-0244-68)

Description of Project: Sewerage and drainage system.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Contract 20 — Fly Creek combined relief sewer.

Completed: February 18, 1970.

Final Project Cost: \$984,795.00.

DETROIT RIVER WATER WORKS SYSTEM (5-0026-66)

Description of Project: A system of treatment, distribution and storage of water to supply the Town of Amherstburg, the Township of Anderdon and the Township of Malden.

Consulting Engineers: C. G. Russell Armstrong Associates Ltd., Windsor.

Contract 1 — 500,000 Imperial gallon elevated tank.

Completed — January 16, 1970.

Final contract cost — \$199,096.00.

Contract 2 — Trunk watermain.

Completed — February 17, 1970.

Final contract cost — \$567,502.00.

Contract 3 — Water treatment plant.

Expected completion date — July 1971.

Estimated contract cost — \$2,312,826.00.

Work on this contract began in July 1970 and has proceeded at a rapid pace.

Estimated Project Cost: \$3,188,541.00.

The elevated tank and trunk watermain have been in service for the greater part of 1970. Completion of construction of the water treatment plant and conclusion of the project is anticipated for mid-1971.

DUNDAS (6-0201-69)

Description of Project: 2,500 lin. ft. of watermain.

Consulting Engineers: Proctor & Redfern Ltd.

Completed: August 12, 1970.

Estimated Final Contract Cost: \$54,314.00.

(watermain only)

Work commenced on July 27, 1970 and was done in conjunction with an elevated steel water tank which was a municipal project but financed by the Commission.

The total value of the watermain and tank project was \$325,000.

EGANVILLE (1-0007-66)

Description of Project: Sewage treatment plant and sewerage system.

Consulting Engineers: J. L. Richards & Associates Ltd., Ottawa.

Contract 1 — Sewers, forcemain and two pumping stations.

Expected completion date — July 1971.

Estimated contract cost — \$559,200.00.

Work commenced in June 1970 and by the end of the year was approximately 80 percent completed.

Contract 2 — Prefabricated sewage treatment plant.

Expected completion date — June 1971.

Estimated contract cost — \$153,300.00.

The erection of the prefabricated sewage treatment unit was completed by the end of the year but the work on yard piping, the control building and site work will be completed in the Spring of 1971.

Estimated Project Cost: \$835,300.00.

EMO (1-0047-66, 5-0017-66)

Description of Project: Complete sewage works and water works systems.

Consulting Engineers: W. L. Wardrop & Associates Ltd., Winnipeg.

Contract 1 — Sanitary sewerage and water distribution systems, sewage pumping station, sewage lagoon and raw water intake.

Completed — December 4, 1970.

Final contract cost — \$577,138.00.

Contract 2 — Water treatment plant.

Expected completion date — May 1971.

Estimated contract cost — \$223,500.00.

Work commenced in September 1970 and by the end of the year was approximately 60 percent completed.

Estimated Project Cost: \$965,700.00.

ERNESTOWN (6-0170-67, 2-0227-67)

Description of Project: Watermains, sanitary sewers, forcemain, pumping station and one additional lagoon cell.

Consulting Engineers: J. D. Lee Engineering Ltd., Kingston.

Completed: October 15, 1970.

Final Project Cost: \$1,070,474.00.

HAMILTON (1-0215-69)

Description of Project: Extensions to the existing 60 m.g.d. primary treatment plant to provide secondary treatment facilities.

Consulting Engineers: Proctor & Redfern Ltd., Toronto.

Expected Completion Date: Summer 1972.

Estimated Project Cost: \$22,570,000.00.

The contract was awarded on January 15, 1970 and work started immediately. Progress has been very good and by the end of the year approximately 66 percent of the work had been completed. The required completion date is May 28, 1973 but it is considered that if the present rate of progress is maintained the work will be completed about a year ahead of this date.

TOWNSHIP OF KING (Oak Ridges) (6-0180-68)

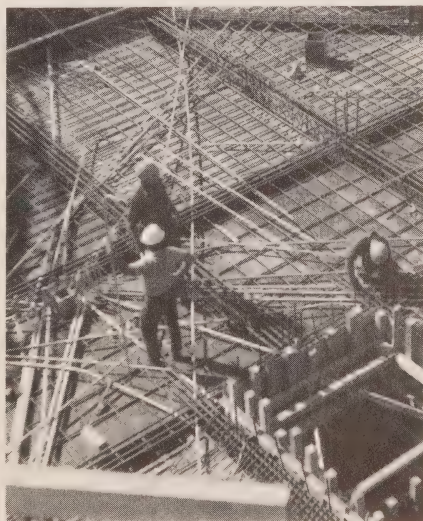
Description of Project: Well pumping station.

Consulting Engineers: Totten Sims Hubicki Associates Ltd., Whitby.

Expected Completion Date: January 1971.

Estimated Project Cost: \$88,000.00.

The project consisted of the supply and installation of filtration and iron removal equipment, together with an extension of the existing building to house the new facilities.

**TOWNSHIP OF KING (Melody Acres) (6-0188-68)**

Description of Project: Water distribution system.

Consulting Engineers: Totten Sims Hubicki Associates Ltd., Whitby.

Completed: October 14, 1970.

Final Project Cost: \$82,000.00.

LAKE ERIE WATER SUPPLY SYSTEM (5-0002-65)

Description of Project: Water supply system from Lake Erie to the St. Thomas area.

Consulting Engineers: James F. MacLaren Ltd., Toronto.

Contracts 1 to 5, 8 and 9: Completed prior to 1969.

Contract 6 — Water treatment plant.

Expected completion date — May 1971.

Estimated contract cost — \$3,194,000.00.

Cost of equipment purchased directly by OWRC — \$500,000.00.

All buildings for the new plant have been completed and installation of equipment has commenced.

Site grading and road work have also started. Inlet and outlet connections to the existing 30 in. pipeline have been completed.

The outdoor substation and auxiliary equipment have been installed but not energized.

Estimated Project Cost: \$12,000,000.00.

LAKE HURON WATER SUPPLY SYSTEM (5-0005-66)

Secondary supply facilities — Town of Parkhill.

Consulting Engineers: James F. MacLaren Ltd., London.

Contract 1 — 100,000 gallon concrete reservoir.

Completed — July 30, 1970.

Final contract cost — \$89,846.00.

Contract 2 — 10 in. diameter water pipelines.

Completed — September 21, 1970.

Final contract cost — \$296,442.00.

Final Project Cost: \$473,072.00.

LAKE TIMISKAMING WATER SUPPLY SYSTEM (5-0015-66, 5-0099-69)

Description of Project: A water supply system comprising a reservoir, treatment plant and watermains.

Consulting Engineers: Canadian Mitchell Associates Ltd., Bramalea.

Contract 'A' — Water treatment plant in Haileybury.

Expected completion date — October 1971.
Estimated contract cost — \$1,058,658.00.

Work started on July 21, 1970 and has progressed well with 50 percent of the concrete structure completed and inside mechanical and electrical work continuing during the winter months. The intake has also been installed in the lake.

Contract 'B' — 400,000 gallon below ground reservoir and pumping station in Haileybury.

Completed — December 1970.

Estimated contract cost — \$275,181.00.

Contract 'C' — 10 in. diameter trunk watermain from the reservoir to North Cobalt.

Completed — November 13, 1970.

Estimated contract cost — \$125,334.00.

Estimated Project Cost: \$1,559,173.00.

LISTOWEL (2-0253-68)

Description of Project: Extensions to the sanitary sewer system.

Consulting Engineers: Peter T. Mitches & Associates Ltd., London.

Completed: June 19, 1970.

Estimated Final Project Cost: \$435,000.00.

LOGLAC (1-0014-66, 6-0189-68)

Description of Project: Sanitary sewerage and water distribution systems, forcemains, three pumping stations and a prefabricated sewage treatment plant.

Consulting Engineers: W. L. Wardrop & Associates Ltd., Thunder Bay.

Contract 1 — Sanitary sewers, forcemains and water distribution system.

Expected completion date — July 1971.

Estimated contract cost — \$553,400.00.

Work commenced in October 1970 and continued until the middle part of December when, due to severe weather and deep frost penetration, work was discontinued and will resume when weather conditions improve.

Contract 2 — Prefabricated sewage treatment plant and three sewage pumping stations.

Estimated contract cost — \$256,500.00.

The drawings and specifications were being reviewed by the various divisions of the Commission at the end of the year and the advertising for tenders is expected in February 1971.

Estimated Project Cost: \$980,000.00.

MADOC (1-0017-66)

Description of Project: Sewage Lagoon and short run of gravity trunk sewer.

Consulting Engineers: J. D. Lee Engineering Ltd., Kingston.

Expected Completion Date: October 9, 1971.

Estimated Project Cost: \$171,130.00.

Work started on November 23, 1970 and most of the bush and wood has been cleared. Construction of the lagoon berms is expected to start early in January 1971.

TOWNSHIP OF MARKHAM (6-0202-69)

Description of Project: Approximately 6,000 lin. ft. of 30 in. diameter watermain and related works.

Consulting Engineers: Crysler, Davis & Jorgensen Ltd., Toronto.

Completed: December 30, 1970.

Estimated Project Cost: \$195,000.00.

MEAFORD (1-0003-66, 2-0251-68)

Description of Project: Sanitary sewers, pumping station, forcemain, outfall sewer and sewage treatment plant.

Consulting Engineers: Proctor & Redfern Ltd., Toronto.

Contract 'A' — Sewage treatment plant consisting of inlet works, clarifiers, digester and control building.

Expected completion date — January 22, 1971.

Estimated contract cost — \$565,000.00.

Work commenced in January and proceeded steadily during the year. Delay was caused by a plumbers' strike.

Contract 'B' — Outfall sewer from the plant into Georgian Bay, trunk sanitary sewer, factory-built underground pumping station and about 5,000 lin. ft. of forcemain.

Expected completion date — March 1, 1971.

Estimated contract cost — \$470,000.00.

Construction equipment was moved to the site in April and work commenced in May. All major items of pipe were installed by September but delivery of the pumping station was delayed because of slow delivery of the variable speed control device. It is expected that the station will be delivered late in February 1971.

Estimated Project Cost: \$1,160,000.00.

NEWMARKET

Description of Project: Addition of full-scale nutrient removal facilities at existing sewage treatment plant.

Expected Completion Date: February 1971.

Estimated Project Cost: \$91,200.00.

The works (excluding detailed structural design) were designed by a committee of Commission staff. Construction was started in early November 1970. It is expected that the facilities will be in operation toward the end of February 1971.

The facility is the first full-scale phosphate removal facility using the lime process developed by the Division of Research.

NORTH GRIMSBY (6-0195-69)

Description of Project: Relocation of watermain.

Consulting Engineers: W. L. Sears & Associates Ltd., Stoney Creek.

Completed: August 10, 1970.

Final Project Cost: \$274,440.00.

PLANTAGENET (6-0181-68)

Description of Project: Pumphouse and treatment equipment.

Consulting Engineers: J. L. Richards & Associates Ltd., Ottawa.

Completed: December 15, 1970.

Estimated Final Project Cost: \$36,000.00.



PORT COLBORNE (2-0243-68)

Description of Project: Rosemount Area Sewerage.

Consulting Engineers: Canadian-British Engineering Consultants Ltd., Port Colborne.
Contract 'A' — Three sewage pumping stations.

Expected completion date — January 1971.
Estimated contract cost — \$313,240.00.

The Rosemount North and South pumping stations were completed during the fall of 1970. However, the Elm Street factory-built pumping station was not delivered until the middle of October 1970 because of a strike at the manufacturer's plant. By the end of the year this station was installed but not energized.

Contract 'B' — Sanitary sewers and forcemains.

Expected completion date — January 1971.
Estimated contract cost — \$1,006,800.00.

This contract was running approximately two and a half months later than the originally stipulated schedule mainly because of rather difficult rock excavation.

Contract 'C' — Sanitary sewers and forcemains.

Expected completion date — January 1971.
Estimated contract cost — \$207,000.00.

Work under this contract was substantially completed towards the middle of December 1970. Following minor finishing work and restoration, it is expected that the system will be placed in operation during January 1971.

PORT PERRY (1-0005-66)

Description of Project: Sanitary sewers, forcemain, pumping station and lagoon.

Consulting Engineers: Canadian Mitchell & Associates Ltd., Bramalea.
Expected Completion Date: August 1971.
Estimated Project Cost: \$1,785,600.00.

The construction of all the sewers and the forcemain and the structural work on the pumping station were completed by the end of the year. The mechanical and electrical work on the pumping station and the construction of the lagoon will be completed in 1971.

PRESCOTT (1-0023-66)

Description of Project: Interceptor sewer, sewage pumping stations and sewage treatment plant.

Consulting Engineers: J. D. Lee Engineering Ltd., Kingston.

Contract 1 — Sanitary sewers, forcemain, two factory-built sewage pumping stations and outfall to the St. Lawrence River.
Expected completion date — March 1971.
Estimated contract cost — \$709,700.00.

The work was virtually completed by the end of the year except for some further work on the two pumping stations. This work is expected to be completed in the beginning of 1971.

Contract 2 — Sewage treatment plant and two built-in-place sewage pumping stations.
Expected completion date — July 1971.
Estimated contract cost — \$645,800.00.

Work was commenced in July and by the end of the year was only approximately 15% completed.

Estimated Project Cost: \$1,593,500.00.

RICHMOND (1-0004-66)

Description of project: Sanitary sewers, forcemain, pumping station and lagoon.

Consulting Engineers: J. L. Richards & Associates Ltd., Ottawa.
Expected Completion Date: February 1971.
Estimated Project Cost: \$614,800.00.

Except for some mechanical and electrical work on the factory-built sewage pumping station and stand-by generator unit, all the work on this project was completed by the end of the year.

RICHMOND HILL (2-0256-68)

Description of Project: An 85 ft. diameter clarifier and ancillary works to increase capacity of the existing plant.

Consulting Engineers: Hisey & Barrington Ltd., Toronto.

Expected Completion Date: July 1971.
Estimated Project Cost: \$225,000.00.

Work commenced in mid-October 1970 on the excavation work for the clarifier and diversion of a creek, utilizing twin corrugated steel culverts. By the end of the year the clarifier and pumping station concrete work were up to ground level and in a position for work to commence by the mechanical and electrical trades.

SOUTH PEEL AREA SEWAGE SYSTEM PROJECTS (1-0053-66)

(The numbers below indicate sub-projects)

-01 Extensions to the Lakeview water pollution control plant.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Contract 1 — Digestion, heating and grit removal facilities.

Expected completion date — September 1971.

Estimated contract cost — \$3,695,294.00.

Work started on this contract in March 1970 and by the end of the year almost all structural work had been completed and all buildings closed in for the winter allowing electrical and mechanical trades to work at full efficiency.

Contract 2 — Settling and aeration works.
Expected completion date — December 1971.
Estimated contract cost — \$6,414,921.00.

Construction started in April 1970 and about 90% of the concrete work had been completed by the end of the year. Electrical and mechanical work continued along with structural work during the winter months but at a slow pace. The contractor on this project cannot close in structures and may suffer delays as a result of weather.



-02 North part of east trunk sewer.

Consulting Engineers: Proctor & Redfern Ltd., Toronto.

It was expected that there would be five contracts under this project but as a result of having to resort to expropriation for the majority of the easements along the sewer route, several smaller contracts were found to be necessary in order to build sections in conjunction with other authorities doing construction in the area.

Contract 4 — Dundas Street to Base Line.
Estimated contract cost — \$5,000,000.00.
Design completed. Property requirements delaying construction.

Contract 4A — Section through Markland Woods Golf Course.

Expected completion date — June 1971.

Estimated contract cost — \$840,172 (including \$200,000 for restoration to be done separately by others).

This is a part of the original Contract 4 being constructed during the winter to avoid disruption of the golf course during the playing season. The contract was awarded in December and work commenced in that month.

Contracts 5, 6 and 7 — Base Line to Steeles Avenue.

Design completed. Property requirements delaying construction.

Contract 7A — Sewer on D.O.T. property.
Completed — October 1970.
Final contract cost — \$70,000.00.

This was part of Contract 7 which was built in conjunction with Department of Transport runway lighting requirements.

Contract 8 — Sewer under D.O.T. runway.
Completed — May 1970.

Final contract cost — \$208,575.00.

-03 West trunk sewer.

Consulting Engineers: Canadian-British Engineering Consultants Ltd., Don Mills.

It is expected that there will be six contracts under this project with a total value of \$10,000.00. The design of all contracts (9, 10, 11, 12, 13) has been completed but property requirements necessitated expropriation proceedings. One contract (14) has been completed.

Contract 14 — Streetsville W.P.C.P. to Alpha Mills Road.

Completed — December 1970.

Final contract cost — \$834,960.00.

Construction commenced in June and completed in December 1970.

It is expected that construction will commence on the remaining contracts between May — July 1971.

The following projects were under design in 1970 with tender calls scheduled for 1971:

-04 Clarkson water pollution control plant.
Consulting Engineers: Gore & Storrie Ltd., Toronto.

Studies on staged development and land use at existing facilities were obtained and reviewed during the year. Design based on the above studies was initiated with an estimated cost of construction of \$6,500,000 for the first stage bringing the plant capacity to 20 M.G.D.

-05 Chinguacousy Branch of east trunk sewer.

Consulting Engineers: Canadian Mitchell Associates Ltd., Bramalea.

Estimated Construction Cost: \$900,000.00

-06 South part of east trunk sewer.

Consulting Engineers: Marshall Macklin Monaghan Ltd., Toronto.

Estimated Construction Cost: \$3,500,000.00.

-07 Lakeview W.P.C.P. extension to 50 M.G.D.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Estimated Construction Cost: \$6,500,000.00.

-08 Modifications to Beach Street pumping station.

Consulting Engineers: McCormick Rankin & Associates Ltd., Port Credit.

Estimated Construction Cost: \$50,000.00.

SOUTH PEEL AREA WATER SYSTEM PROJECTS (5-0020-66)

(The numbers below indicate sub-projects)

-02 Lakeview water purification plant.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Contract 3 — Filters 11-18.

Expected completion date — September 1971.

Estimated contract cost — \$2,400,000.00.

Work commenced on this contract in October 1969 and by the end of 1970 all structural work was completed. Two filters were placed in operation in June 1970 which was a requirement of the contract in order to meet summer demands. It is expected that

this contract will be completed ahead of the scheduled completion date shown above.

Contract 4 — Additions to the low and high lift pumping stations.

Expected completion date — April 1971.

Estimated contract cost — \$723,000.00.

Construction started in June 1970 and by the end of the year work had progressed to the stage where the majority of the pre-ordered pumps and equipment had been installed as well as most of the new discharge piping.

-03 36 in. diameter Queensway feedermain.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Completed: June 1970.

Final Project Cost: \$411,750.00 (includes \$130,000 for land, legal and surveys).

This project was commenced in February and completed on schedule.

-04 60 in. diameter Silverthorn feedermain.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Completed: October 1970.

Final Project Cost: \$1,520,760.00.

Construction of the feedermain started in February and was completed in October. The northerly section, joining the Queensway feedermain, was completed and placed in service in June to meet summer demands.

-06 Beckett-Sproule reservoir and pumping station.

Consulting Engineers: W. O. Chisholm & Associates (Eastern) Ltd., Scarborough.

Contract 7 — Temporary pumping station.

Completed — June 1970.

Final contract cost — \$60,000.00.

A temporary 5.0 M.G.D. diesel driven pump was installed at the site to provide standby capacity to meet summer demands in the area.

Contract 8 — Permanent pumping station and reservoir.

Expected completion date — April 1972.

Estimated contract cost — \$1,832,000.00.

The contract was awarded in late December 1970 and work is expected to start early in January 1971.

-07 Hanlan feedermain — Silverthorne to Burnhamthorpe.

Consulting Engineers: McCormick, Rankin & Associates Ltd., Port Credit.

Completed: August 1970.

Final Project Cost: \$250,000.00.

Construction was commenced in May and completed in August.

-08 Hanlan feedermain — Burnhamthorpe to Hanlan.

Consulting Engineers: Canadian-British Engineering Consultants Ltd., Don Mills.

Contract 5 — Burnhamthorpe to Base Line.

Completed — December 1970.

Final contract cost — \$408,000.00.

This contract was commenced in August and completed in December 1970.

Contract 6 — Base Line to Hanlan.

Estimated contract cost — \$750,000.00.

Design of this contract was completed in the summer of 1970 after numerous changes due to property requirements. It is expected that tenders will be called by May 1971, following completion of property acquisitions.

-09 Silverthorn pumping station revisions.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Contract 9 — Discharge main.

Expected completion date — September 1971.

Estimated contract cost — \$563,000.00.

Construction commenced in October 1970 and is on schedule. By the end of the year the contractor had installed about 20% of the discharge main as well as completing the base slab for the main valve chamber.

Contract 10 — Increase in pumping capacity.

Expected completion date — April 1972.

Estimated contract cost — \$900,000.00.

Tenders were received in mid-December and it is expected that a contract will be awarded in January 1971.

-10 Hanlan pumping station revisions.

Consulting Engineers: Proctor & Redfern Ltd., Toronto.

Expected Completion Date: April 1972.

Estimated Project Cost: \$1,966,000.00.

The contract for this project was awarded in late December 1970 and the contractor moved on to the site. Work was confined to top soil stripping only in 1970.

-19 Streetsville interim supply.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Completed: July 1970.

Final Project Cost: \$41,000.00.

In order to provide the Town of Streetsville with water following the taking out of

service of the Streetsville water plant during construction of a trunk sewer through the plant head pond, two temporary booster pumping stations were built allowing the Town to be supplied with lake water.

The following projects were under design in 1970 with tender calls scheduled for 1971:

-13 East Brampton reservoir feedermain.

Consulting Engineers: Canadian Mitchell Associates Ltd., Bramalea.

Estimated Construction Cost: \$1,500,000.00.

-14 East Brampton reservoir and pumping station.

Consulting Engineers: W. O. Chisholm & Associates (Eastern) Ltd., Scarborough.

Estimated Construction Cost: \$1,750,000.00.

Valves for the project were ordered in 1970.

-15 Herridge reservoir and pumping station.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Estimated Construction Cost: \$3,500,000.00.

Pumps for the station were ordered in 1970.

-16 Thomas Street Reservoir feedermain.

Consulting Engineers: Marshall Macklin Monaghan Ltd., Toronto.

Estimated Construction Cost: \$1,500,000.00.

Valves for the project were ordered in 1970.

-17 Thomas Street Reservoir and pumping station.

Consulting Engineers: R. V. Anderson Associates Ltd., Toronto.

Estimated Construction Cost: \$1,600,000.00.

Pumps for the station were ordered in 1970.

-18 60 in. diameter Silverthorn feedermain (2nd section).

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Estimated Construction Cost: \$800,000.00.

The main line valve was ordered in 1970.

STAYNER (1-0021-66)

Description of Project: Sewage collection system, factory-built pumping station, forcemain and a 2-cell lagoon.

Consulting Engineers: Ainley & Associates Ltd., Collingwood.

Completed: November 1970.

Estimated Project Cost: \$900,000.00.



THUNDER BAY (Neebing Ward) (6-0197-69)

Description of Project: Water distribution system, Stage II.

Consulting Engineers: W. L. Wardrop & Associates Ltd., Thunder Bay.

Completed: December 23, 1970.

Estimated Final Project Cost: \$900,100.00.

TIMMINS (2-0250-68)

Description of Project: Installation of a gas recirculator unit.

Consulting Engineers: Gore & Storrie Ltd., Toronto.

Expected Completion Date: June 1971.

Estimated Project Cost: \$25,000.00.

This unit was to have been installed in the original contract but was left out at that time for financial reasons.

Mechanical installations are complete; however, a permanent electrical connection will not be made until June 1971.

TWEED (2-0249-68)

Description of Project: Storm sewers and two outfalls to the Moira River.

Consulting Engineers: Oliver Lloyd & Associates Ltd., Don Mills.

Completed: October 5, 1970.

Estimated Final Project Cost: \$245,100.00.

UNION WATER SYSTEM (6-0185-68)

Description of Project: Extensions to the existing water treatment plant.

Consulting Engineers: C. G. Russell Armstrong Associates Ltd., Windsor.

Completed: November 23, 1970.

Estimated Final Project Cost: \$686,000.00.

WALLACEBURG (2-0181-65, 2-0226-67, 1-0087-67)

Description of Project: A sewage treatment plant, sewage pumping stations, forcemains and sanitary sewers.

Consulting Engineers: Todgham and Case Ltd., Chatham. Gore & Storrie Ltd., Toronto.

Contracts 1, 2, 2A and 3 — Completed prior to 1970.

Contract 4 — Napier-Dundas pumping station. Completed — February 15, 1970.

Final contract cost — \$76,413.00.

Contracts 5A, 5B and 5C — Sanitary sewers and forcemain.

Estimated contract cost — \$1,577,500.00.

Tenders not yet called (see schedule comment below).

Contract 6 — Agnes Street pumping station. Estimated contract cost — \$148,500.00.

Tenders not yet called (see schedule comment below).

Contract 7 — Forcemain river crossings. Completed — September 2, 1970.

Final contract cost — \$70,101.00.

Contracts 8, 9, 10 and 12 — Sanitary sewers and pumping stations.

Estimated contract cost — \$1,745,019.00.

Tenders not yet called (see schedule comment below).

Contract 11 — Sewage treatment plant.

Completed — November 23, 1970.

Estimated contract cost — \$1,316,000.00.

The plant was substantially completed during November and has been treating sewage since that date.

Estimated Project Cost: \$7,889,660.00.

Schedule: It is likely that contracts for which tenders have not yet been called will only proceed to construction if outright Provincial assistance is given.



Division of Finance

E. F. Heath,
Director and Comptroller
J. C. McTeague,
Assistant Director

During 1970 the Division of Finance continued to direct the functions of accounting control, management of funds and financial analyses and reporting within the Commission. These functions are handled by the following branches: Administration, General Accounting, Budget, Internal Audit and Insurance. The activities of these branches in carrying out their respective services are described hereunder.

ADMINSTRATION BRANCH

In addition to directing and coordinating the overall activities of the Division, the Adminstration Branch deals with the financial problems and other special aspects of municipal and provincial projects. Some of the more significant matters dealt with during the year were the following:

(a) South Peel County Acquisitions

The Administration Branch, together with the Audit Branch, undertook the verification of some thirty-five water works and fifteen sewage works acquired under the South Peel Agreements. The acquisitions required extensive verification of capital costs and required close liaison with municipal officials, consulting engineers and industry. The preparation of final acquisition costs are now substantially completed and the final release of payments are expected to be made in early 1971.

(b) Rate Reviews

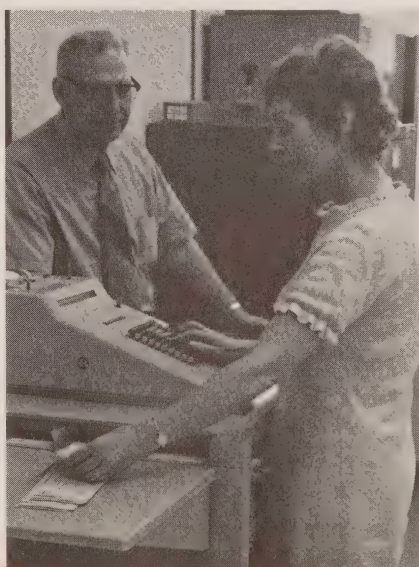
In keeping with the basic terms of the Agreements under the Provincial Programs, three projects, namely, the Village of Bobcaygeon, the Village of Woodbridge and the Town of Haileybury were scheduled for rate reviews in 1970. In these rate reviews, the entire features of the system, i.e. costs, financing arrangements, operating expenditures, revenue forecasts and water and sewage flow patterns come under review and a new rate is established in light of existing conditions affecting the project.

(c) OWRC Debentures

During the year, OWRC debentures were issued to the Central Mortgage and Housing Corporation as security for loans applied to the following sewage projects: Village of Beaverton, Village of Beeton, City of Cornwall, Townsite of Ear Falls, Town of Haileybury, Townsite of Moosonee, Village of Pickering, Townsite of Red Lake and Village of Woodbridge.

(d) Provincial Assistance

Under the Government's financial assistance program to municipalities in the provision of water and sewage facilities, there were five completed Provincial Programs which became eligible during the year for provincial assistance. Financial data were provided for the calculation of the rate of financial assistance and amortization schedules were prepared. Total provincial assistance, to date, related to projects in operation amounts to \$5,507,819.



GENERAL ACCOUNTING BRANCH

The General Accounting Branch is responsible for the preparation of the Commission's Head Office and Plant Operators payrolls, the processing and payment of all general expenditures, capital disbursements and plant operating expenditures, as well as the collection of all billings issued to municipalities in accordance with the existing project agreements.

During 1970, general expenditures, capital disbursements and capital reimbursements increased substantially over 1969. The majority of the capital reimbursements represent loan advances from CMHC received and applied to the costs of projects.

	1969	1970
General Expenditures	\$ 9,873,529	\$11,307,780
Gross Capital Disbursements (Municipal and Provincial Projects)	26,723,986	49,011,139
Capital Reimbursements (Municipal and Provincial Projects)	7,201,232	13,009,235

The following amounts represent the billings to municipalities for Municipal and Provincial projects. Municipal billings are for amounts due to the Commission for debt retirement, reserve for contingencies, interest charges and operating expenses. Provincial billings are for amounts due to the Commission for water consumed and sewage treated:

	1969	1970
Municipal Projects Billings	11,200,116	\$10,839,968
Provincial Projects Billings	4,061,857	7,285,451



Funds received from municipal projects for debt retirement and reserve for contingencies accounts were invested by the OWRC Investment Committee in accordance with the OWRC Act.

	1969	1970
Debt Retirement Fund	\$ 1,969,838	\$ 1,914,478
Reserve for Contingencies Fund	634,225	603,137

The balances in debt retirement and reserve for contingencies funds at December 31 were as follows:

	1969	1970
Debt Retirement Fund	\$16,291,207	\$19,088,909
Reserve for Contingencies Fund	5,142,704	5,858,361

Plant operating expenses were paid from billings to municipalities for the operation of completed projects at December 31.

	1969	1970
Municipal and Provincial Projects	\$ 5,129,501	\$ 6,674,830

The status of loan advances from the Province of Ontario for the purpose of constructing water and sewage projects at December 31 was as follows:

	1969	1970
Municipal Projects	\$84,121,493	\$86,151,570
Provincial Projects	61,283,226	96,391,057

Interest payments were received with respect to completed projects and applied as a reduction of interest due to the Province of Ontario on Commission borrowings at December 31.

	1969	1970
Municipal and Provincial Projects	\$ 7,555,420	\$ 8,470,000

The following are the interest rates and amounts payable to the Province of Ontario on the total borrowings for all projects at December 31:

	1969	1970
Interest Rate	6.26%	6.89%
Amount Payable	\$ 9,098,925	\$12,584,518

BUDGET BRANCH

During the year, the Budget Branch assembled, analyzed and co-ordinated all pertinent costs for the preparation of the Commission's annual and multi-year budgets, maintained financial control of funds appropriated for its programs and activities, and provided assistance at the divisional level for the preparation of the annual estimates. In the 1970-71 fiscal year, the general expenditures for the Commission's programs are estimated at \$12,485,000. These expenditures were reported on a monthly basis to various levels of management in comparative budget/actual format. Additional analytical and cost information was provided as necessary.

In order to maintain the essentials of a good budget and cost analysis system, an Account Codes Handbook, based on the Common Object Expenditure Codes designed by the Department of Treasury and Economics, is being prepared by the Branch and will be distributed to management. This will ensure uniformity, not only in the identification of financial transactions but also in the submission of estimates for budgetary and other requirements. Each year's classified expenditures provide additional cost records and historical data on the various activities of the Commission and are most useful in assessing future estimates as well as providing essential information on current patterns and long-term forecast trends necessary to meet established program objectives.

In addition to the internal reports produced for management, various monthly and quarterly statements were prepared for the Department of Treasury and Economics, the Treasury Board, the Dominion Bureau of Statistics, the Federal Audit Services Division, as well as for other agencies.

AUDIT BRANCH

The Internal Audit Branch is responsible for an independent review of existing accounting and administrative controls, policies and procedures throughout the Commission. The purpose of this review is to ensure that Commission assets are safeguarded from losses of all types, and to determine the adequacy and application of accounting controls and the extent of compliance with respect to existing controls, policies and procedures.

These objectives were attained by pre-auditing all project operating expenditures including payrolls, petty cash and travel claims for plant employees, as well as year-end precepts, quarterly billings and supporting schedules. In addition, a limited pre-audit was made of all capital disbursements and some general expenditures. All salary expenditures for seasonal casual employees are pre-audited prior to payment.

Post-audits were completed with respect to both Head Office and Plant Operations travel claims, inventory control, interest on capital draws, project salary cost allocations and monthly plant operating statements.

Considerable time was spent during 1970 in finalizing the review of municipal records located at Brampton, Streetsville, Port Credit and Chingau-cousy in order to verify the acquisition costs of assets acquired under the South Peel County Agreements. In addition, a detailed examination was made of records maintained by the Mississauga Water Commission, in order to substantiate the original costs with respect to

Division of Industrial Wastes

D. P. Caplice,
Director
H. A. Clarke,
Assistant Director

water mains rented under the South Peel County Water Service Agreement.

Special assignments during 1970 included the allocation of operating costs for those OWRC/Municipal projects which were taken over as provincial projects. These consisted of Arthur, Belleville, Tillsonburg, Wallaceburg and a number of projects included in the South Peel County Program. The Branch also continued to provide project cost information to the Division of Plant Operations for the preparation of annual statements.

INSURANCE BRANCH

Due to the completion of various construction contracts in 1970, the Commission's insurance coverage on plants and equipment increased to \$107,288,755 (Municipal \$57,574,903 and Provincial \$49,713,852) from \$100,360,700 in 1969. The increase of \$6,928,055 is the net increase after deleting the coverage on the OWRC/Municipal projects which were terminated during the year.

The number of claims processed during the year was 36 and the claim payment received totalled \$22,283.

The Branch continued to act in a consulting and advisory capacity to the Petroleum Resources Section of the Department of Mines and Northern Affairs.

The Division of Industrial Wastes is responsible for the administration of the OWRC industrial pollution control program and performs a regulatory function, principally under Sections 27, 31 and 50 of the OWRC Act. The activities of the Division are co-ordinated by the Administration Branch and fall into three general areas: Field Services, Design Approvals and Special Projects.

The Field Services Branch regularly surveys all sources of industrial pollution of the aquatic environment and prepares reports describing the quality and quantity of the discharges. The status of pollution control at each industry is assessed and appropriate remedial measures are recommended where required to bring effluent quality in line with OWRC objectives. An extensive surveillance program is maintained throughout the Province to ensure continuous and satisfactory quality control on discharges to water-courses. Problems associated with existing discharges of industrial wastes to municipal sewerage systems are investigated.

The Design Approvals and Special Projects Branch carries out the following functions: (a) it reviews engineering plans from industry where the effluent from the proposed treatment works is to be discharged to a watercourse or storm sewer, and issues certificates of approval under the terms of Section 31 of the OWRC Act; (b) it arranges public hearings concerning applications where the proposed treatment works are to extend from one municipality to another; (c) it provides specialized technical appraisal of difficult waste control problems on an individual-company or industry-wide basis; (d) it reviews design reports for provincially-financed municipal sewerage schemes with respect to industrial waste contributions; and (e) it provides advice and assistance to municipalities in the preparation of sewer-use by-laws to regulate industrial discharges to municipal sewers.

A more detailed account of the

activities of these two branches during 1970 follows:

FIELD SERVICES BRANCH

Continuing decentralization of the OWRC, with consequent posting of technical staff to field offices, has improved considerably the quality of service rendered to industry and the public. The Division currently has staff located in Thunder Bay, Sudbury, Sault Ste. Marie, London, Sarnia, Peterborough and Kingston, with additional moves expected in the near future to other centres in the Province. It is now possible to give closer attention to local pollution problems, response to public complaints is more efficient, investigations of accidents and spills are conducted more quickly than before, and information dissemination programs in communities where such problems have arisen have improved markedly.

Field personnel conducted 83 full-scale surveys, made about 2,850 field contacts and produced 39 detailed industrial waste reports in 1970. Copies of these reports were forwarded to the companies in question and appropriate actions to control pollution were requested. In assisting the development of waste treatment and disposal schemes to the design-approval stage, field staff participated in approximately 570 meetings. As an indication of the changing emphasis in the activities of the Branch, in-depth pollution surveys are done less frequently today than five years ago as most problems have now been identified. Instead, meetings with industrial officials are increasing as greater numbers of treatment proposals are submitted for OWRC approval. Routine surveillance visits and unannounced spot-checks of industry to evaluate the efficiency of treatment plants and to monitor effluent quality are also increasing. The following comparative figures indicate the change of emphasis:

	1966	1967	1968	1969	1970
Meetings	157	275	281	378	573
Field Visits	1,516	1,911	2,200	2,300	2,854
Treatment Plans Reviewed	93	105	99	138	174

The mechanisms for making early contact with new industries coming into the Province are well established and interdepartmental co-operation is at a high level. As an aid to proper planning, discussions were held with more than 50 new firms regarding the suitability of site location in relation to water management aspects, manufacturing processes which can contribute to water pollution, and methods for the control and treatment of liquid wastes. Also, a pollution incident prevention program (PIPP) is being implemented in Ontario in a major effort to prevent or minimize accidental discharges of materials from industry to receiving watercourses.



BASIC IRON AND STEEL

At the end of 1969, the three major iron and steel producers, Dominion Foundries and Steel, Limited (Dofasco), The Steel Company of Canada, Limited (Stelco), both located in Hamilton, and The Algoma Steel Corporation, Limited (Algoma) in Sault Ste. Marie, announced comprehensive control programs staged over a five-year period to clean up remaining major sources of pollution. While improved waste controls were put into effect in 1970, the major efforts by the companies were in the development and engineering of items in the staged programs. One project common to all mills was the initiation of routine sampling and analysis of all waste effluents with data submission to the Division on a regular basis.

Recent improvements were effected by Algoma with the completion of the phenol recovery plant, additional baffles and an oil skimmer on the terminal lagoon, and improved oil removal from the bar and strip mill wastes. Proposed facilities include a second clarifier for iron and suspended solids removal to be completed by the end of 1971, clean-up of the coke oven by-product area by 1972, and acid and oil control in the cold mill area by 1973.

Reductions in suspended solids and iron loadings to Hamilton Bay were achieved by Dofasco in 1970 through improvements in the melt shop slurry system, and the purchase and operation of a portable dredge in the terminal settling lagoon. Other current projects include sanitary sewage collection, temporary facilities for a new slabbing mill, and several items in the coke plant by-product area — notably ammonia removal with incineration. Development work is continuing on major items such as pickle liquor recovery, filtration of suspended solids and chemical treatment of oil.

Stelco recently completed phase 1 of the sanitary sewage segregation sys-

tem, conversion of the last pickle line to hydrochloric acid, and increased capacity for the final coolers in the coke plant area. Projects under construction include an expansion of the acid regeneration plant and scale pits for a new bloom and billet mill. Development work is continuing on the control of heavy metals from the tinning lines, diversion of coke plant wastes to the municipal treatment plant, removal of ammonia from coke plant wastes, and cyanide and suspended solids control in the blast furnace area.

CHEMICAL AND PETROLEUM

Significant gains were achieved in 1970 in the control of pollution from the chemical and petroleum industries. Forty-two applications for the installation of pollution abatement works were approved at an estimated capital cost of \$3.2 million. These cost figures do not include appreciable expenditures for in-plant control measures such as recirculation, process modification and by-product recovery, which do not require approval under the terms of the OWRC Act but which contribute greatly, nevertheless, to pollution control.

The chemical and petroleum industries have generally dealt in a satisfactory manner with such pollutants as oil, suspended solids and biodegradable organic compounds. However, an awareness is growing of the adverse effects on the environment of less well-known materials such as dissolved inorganic salts and persistent organics. During the year, a major environmental pollution problem was recognized in the form of contamination of fish flesh by mercury discharged from chlor-alkali plants.

Major pollution abatement works were undertaken or completed by the following companies in 1970: Dow Chemical of Canada, Limited, Sarnia and Thunder Bay; Allied Chemical of Canada, Ltd., Amherstburg; Marbon Chemical Division of Borg-Warner

(Canada) Limited, Township of Hamilton; Polymer Corporation Limited, Sarnia; Sun Oil Company Limited, Sarnia; Imperial Oil Enterprises Ltd., Sarnia; Gulf Oil Canada Limited, Mississauga; and Shell Canada Limited, Township of Moore.

Although the daily control of wastes has been generally satisfactory in the industries under discussion, many problems continue to arise because of such factors as accidental spills and process upsets. Greater emphasis has been placed upon dealing with problems of this nature and industries have been requested to assess the potential for spills and to take suitable preventative action. Contingency plans have been developed by the petroleum refining industry in Ontario to deal with accidental losses of oil. Treatment facilities have also been built to intercept and treat wastes resulting from such incidents. Under recent amendments to the OWRC Act, unusual losses of chemicals must now be reported to the OWRC at the time of the occurrence. Failure to do so can result in financial penalties upon conviction.

The petroleum industries in the Sarnia area were faced with an unexpected problem during 1970 as a result of difficulties associated with subsurface disposal. Several industries in the area had, for a number of years, disposed of wastes, that were difficult and expensive to treat, by injecting them, by means of deep wells, into the porous Detroit River rock formation underlying the area. Field inspections indicated that these wastes could be pressurizing formations to the point where underground fluids were migrating up unproductive oil and gas wells in Ontario and Michigan. As a result, the government departments concerned with deep well disposal practices developed new guidelines which were provided to industries in the vicinity of the St. Clair River. These guidelines call for a phasing out of this method of disposal

or cutbacks in the volumes of wastes being disposed in this manner. All of the industries involved have programs underway for development of satisfactory alternate methods of disposal within a two-year target period.

FOOD PROCESSING

This industrial classification includes meat, fruit and vegetable processing plants, milk processing plants, canneries, breweries and distilleries.

Much progress has been made in eliminating the pollution problems in the food processing industry over the past two years. Twenty-one certificates of approval were issued by the Commission for the installation of treatment facilities in 1969, with a total value of \$1,960,000 and an additional 13 certificates were issued in 1970 with an

estimated value of \$715,700.

Canneries continue to pose one of the most difficult waste control problems in the food processing industry, because of the short operating season at many plants, and the strong wastes that are generated, requiring extensive treatment facilities. However, acceptable programs have been arrived at with most of the canneries in the Province. One such case is the H. J. Heinz Company of Canada Ltd. in Leamington.

Two other examples of companies installing pollution control works might be noted. Nestlé Canada Ltd., Chesterville, has modified its aerated lagoon to a conventional activated sludge unit and has greatly improved the degree of treatment for its organic wastes. Omstead Fisheries 1961 Limited in Wheatley is carrying out pilot studies in an aerated lagoon on combined fish and vegetable wastes. Data from this project are to be used to design a full scale treatment plant which is scheduled for construction in late 1971.

Most of the milk processing plants in the Province have facilities which, when operated properly, provide satisfactory treatment of their wastes. However, the provision of satisfactory waste treatment on a continuous basis at small milk processing plants still presents a problem. Where municipal sewers are not available, small plants have utilized land disposal because of low capital costs. However, for satisfactory results, land disposal procedures require constant attention on the part of the operator and, often, this needed attention has not been provided. The result has been the pollution of both air and water.

The problem of waste treatment at the small processing plant is partly being overcome by a trend towards consolidation in the milk industry. Smaller plants are closing and production is being carried out in larger viable units which are in a better financial position to install more reliable waste treatment facilities.



Consolidation has been most evident in the Ottawa and St. Lawrence valleys, and in southwestern Ontario, but has been relatively slow in the Belleville area. A system of grants, recently introduced by the Department of Agriculture and Food, is expected to accelerate the consolidation of the industry.

The milk industry's waste disposal problem in the Belleville area is compounded by the lack of a market for whey which is a by-product of cheese manufacturing. Approximately 90 percent of the whey is disposed of on land, as compared to about 15 percent in other areas of the Province. Alternative methods of whey disposal were investigated by the Division and it was concluded that spray drying to make an edible product was the most economical. A report on the feasibility of a spray drying plant has been prepared in the hope that it might encourage the construction of such a plant.

MINING AND METALLURGICAL

This industrial classification includes hardrock mining and/or milling, sand and gravel operations, limestone quarries and smelting and refining operations.

During the two-year period January 1, 1969 to December 31, 1970, a total of 46 applications from the mining industry were approved for the installation of waste treatment facilities. The capital and engineering cost of works proposed in these applications totalled \$2,830,000 (1969 — \$958,400; 1970 — \$1,871,700). Approximately 50 percent of these expenditures were concentrated in the Sudbury and Elliot Lake areas and were as follows:

Sudbury:

(a) International Nickel	\$556,000
(b) Falconbridge	\$216,000

Elliot Lake:

(a) Denison Mines	\$200,000
(b) Rio Algom (Quirke)	\$400,000
(c) Stanrock Uranium	\$44,000

Waste treatment expenditures at present are directed towards the engineering, construction and maintenance of tailings areas, and, to a lesser extent, the chemical treatment of mine water.

The mining industry, in response to increasing public and government pressure, has recognized the need for improved waste control measures. Tailings areas are better planned and engineered and, as a result, major dyke failures are becoming rare. Suspended solids carry-over from tailings areas is now under control in most locations. In addition, an increasing number of mine-mill

operations are practising water re-use of tailings decant water within the mill. Where feasible, this practice is strongly advocated by the OWRC to minimize the discharge of dissolved materials, particularly into the soft waters of northern Ontario.

Programs involving the revegetation of waste rock piles and abandoned tailings areas are now in effect at various locations in the Province, including Timmins, Sudbury, Elliot Lake and Manitouwadge. In the Timmins — Sudbury area, approximately 2,500 acres of tailings have been revegetated. Recent legislation of the Ontario Department of Mines and Northern Affairs now requires the revegetation of tailings areas as soon as operations cease at any particular property.

In 1968, a detailed examination of the chemical characteristics of tailings area effluents and seepage flows began in the Elliot Lake area. In 1969 and 1970, this investigation was expanded to include other mining areas and operations. The seriousness of the acid mine drainage situation was realized as a result of the study and in 1970 the Division began to take positive steps to overcome the problem. One other major technical report initiated in 1970 concerning the chemical nature, toxicity and biodegradability of mill reagents is being prepared.

PULP AND PAPER

Considerable progress was made in the pulp and paper industry during 1970 in the finalization of plans for waste control and the commitment of monies for these projects. The actual reductions in pollutant loads achieved during 1970 were minor but the benefits of the work undertaken during the year will be reflected over the next five years as committed projects are completed and brought into operation.

Since December 1967, there has been an overall reduction of approximately 25 million gallons per day in the total water consumption by the mills, bringing it to a level of 460 million gallons per day. Also, suspended solids discharges have been reduced over the same period by approximately 220 tons per day, to a level of 560 tons per day. Biochemical Oxygen Demand (BOD₅) levels remain essentially the same at approximately 970 tons per day. Actual reductions accomplished during this period are probably greater than reflected by these figures because more accurate and improved monitoring techniques have, in many individual cases, shown up greater waste loadings than were reported in 1967.

During 1970, the OWRC issued six certificates of approval for waste treatment works for an estimated total expenditure of \$6,925,000. Since 1965, a total of 29 certificates of approval have been issued for an estimated total expenditure of approximately \$17 million.

At the close of 1970, three mills were operating mechanical clarifiers and two mills were using vacuum filters as external means to reduce the levels of suspended solids discharges. Seven primary lagoons or sedimentation basins were in operation and three lagoons were being used as foam traps to prevent the discharge of excessive amounts of foam to the receiving waters. Much progress has been made in the area of "bark-fibres" handling and mechanical

systems are in operation at ten mills.

Many improvements have been made within mills by better in-plant control techniques. These have included the installation of savealls and broke pulpers, better re-use of whitewaters and the construction of systems to handle in-plant spills and dumps. It is also apparent that plant personnel are becoming more pollution conscious.

During 1970, a large number of proposals for scheduled waste control programs were submitted to the OWRC and given approval "in principle". As a result, it is expected that 21 clarifiers will be installed at mills during the next few years, the majority of them before December 31, 1972.

With regard to secondary treatment, the OWRC has received a number of commitments. In addition to a biological system for a new kraft mill in northwestern Ontario, four biological systems are expected to be constructed during the period 1972 — 1975 to treat kraft mill effluents as well as neutral sulphite semi-chemical spent liquors. A further commitment for a biological system to treat kraft mill wastes has been received but the date of its installation has yet to be finalized. Additional biological treatment systems are expected to become operational at later dates as part of very large comprehensive waste treatment proposals for selected mills, and many treatability studies are being conducted to ensure correctly-designed facilities.

Commitments have been received for the installation of two spent sulphite liquor chemical recovery systems. The first of these is expected to be operational towards the end of 1972 and the second is scheduled for completion in 1974.

A major study into the sources and possible elimination of chemical components responsible for toxicity, taste and odour, and fish flesh tainting associated with kraft mill discharges was commenced by a major pulp and paper

company during 1970. One of the main aims of this study is to try to find alternative methods to biological oxidation as a means of controlling these objectionable components. It is now becoming apparent that pressures being exerted by the regulatory authorities on this industry are finally resulting in some long-needed Canada-wide research into the pollution problems associated with pulp and paper manufacture.

During 1970, the Commission proceeded with legal action under Section 27 of the OWRC Act against six pulp and paper companies, obtaining convictions against five. The use of legal action by the Commission served to stimulate the Industry as a whole into more action being taken on its pollution problems. Also, three Commission Orders under Section 50 of the OWRC Act were issued against pulp and paper companies to legally require the undertaking of treatment commitments made to the Commission.

SECONDARY INDUSTRIES

This industrial classification includes tanneries, textile mills, automotive industries, metal plating and fabricating plants, rendering plants, manufacturers of building products and the service industries. Many of these companies are generally located within municipalities and hence discharge their process wastes to sanitary sewer systems, often after suitable pretreatment, for final treatment at municipal sewage treatment plants. However, there were a number of instances where isolated industries provided their own treatment facilities and discharged the wastes directly to watercourses. During 1970, 36 certificates of approval were issued for treatment works involving a total expenditure estimated at \$13,160,000 where the resultant effluent was discharged directly to a watercourse.

Oil losses from storage facilities and from distribution systems were the

cause of several complaints during the past year. Marketing officials of the major oil companies were advised to critically review the potential for such losses at bulk storage and bulk transferring stations and institute preventative measures. Also, the rail transportation industry continued its efforts to control oil-bearing liquid wastes at maintenance shops and fuelling stations.

A number of Ontario Hydro's power generating stations implemented pollution control programs during 1970 involving fly ash and wet ash effluent handling and treatment procedures. In excess of \$10,000,000 was approved by the OWRC to be spent by the service and utility industries for water pollution abatement measures, of which total approximately \$8 million were earmarked for the 4,000 megawatt coal burning electrical power generating station at Nanticoke on Lake Erie.

The metal fabricating and plating plants discharge wastes containing toxic components such as cyanides, and heavy metals in solution. If discharged indiscriminately to a sanitary sewer, these wastes may upset the proper operation of a sewage treatment plant and, if discharged to a watercourse, they may

Industrial Wastes Sampling



cause extensive fish kills or result in a general deterioration of the aquatic environment. Such industries normally need simple pretreatment of wastes to meet the requirements set out in municipal sewer-use by-laws. Hahn Brass Limited at New Hamburg, and Amerock Limited at Meaford, have installed comprehensive pollution control systems, at an estimated total cost of \$300,000, to render their effluents acceptable for discharge to receiving watercourses.

ENFORCEMENT MEASURES

Although co-operation from industry in general was good, it was necessary to take legal action against firms which failed to develop satisfactory pollution abatement programs. In some cases, negligence or lack of supervision of employees resulted in pollution mishaps, and appropriate legal action was initiated.

Twenty-five firms were charged under Section 27(1) of the OWRC Act which prohibits the discharge of materials which may impair the quality of water. Convictions were gained on 35 individual counts and fines totalling approximately \$17,000 were levied. One conviction under Section 31 of the Act was registered against a company which failed to apply for the Commission's approval prior to construction of its treatment facilities.

When mercury was recognized as a serious environmental problem, Section 50 of the OWRC Act was quickly invoked to terminate the use of mercury-based slime control agents in six paper mills. This Section permits the Commission, with the Minister's approval, to order a company to adopt measures to eliminate or control pollution, including the installation of treatment facilities within a stated time schedule, or to legally bind companies to carry out commitments made to the Commission. Six chlor-alkali plants producing chlorine and caustic soda by mercury cells were ordered to reduce mercury losses

to watercourses to the lowest practicable level. Remedial action was effective in bringing about rapid control. In all, 19 Commission Orders were issued in 1970. Twelve dealt with the mercury problem, three with paper mills and the remainder with various types of industry.

DESIGN APPROVALS AND SPECIAL PROJECTS BRANCH

(a) *Design Approvals*

Control of industrial waste disposal is regulated through the implementation of Section 31 of the OWRC Act which requires industries to submit applications to the Commission for approval of plans for the collection, transmission, treatment and disposal of industrial wastes. Applications are reviewed and, if found satisfactory, certificates of approval are issued. Prior to approval, however, consideration is given to the holding of public hearings under Section 32 of the Act. Hearings are mandatory if the installation involves transporting wastewaters across municipal boundaries for purposes of treatment or disposal. Hearings are optional in other cases.

News releases announcing OWRC approvals are prepared to inform industry, other government agencies and the general public of the continuing growth of industrial waste treatment in the Province.

Table I summarizes the applications processed in 1970 and Table II presents a breakdown, by industrial classification, of the 124 certificates issued involving estimated total expenditures of \$25,514,500. In addition, 19 other submissions were given concurrences at an estimated cost of \$1,632,200. These latter control facilities were not subject to Section 31 of the Act as they were classed as in-plant control measures, non-effluent systems involving wastewater re-use, or pretreatment systems with discharges to municipal sewage

treatment plants. At the year end, 46 applications were outstanding, involving an estimated expenditure of \$9,066,400.

The most comprehensive proposal for an industrial waste system was submitted by H. J. Heinz Company of Canada Ltd. to serve its cannery at Leamington at a total cost of \$480,000. Initially, the company carried out an extensive in-plant study to identify all sources of wastes and it implemented tighter in-plant control measures to reduce the volume and strength of wastes sewered. A consulting engineering firm, retained by the company, carried out pilot plant studies of various biological treatment processes in order to be able to choose the most feasible process and to establish design parameters on which a final waste treatment system could be based. In June, a complete proposal was submitted to and approved by the OWRC, involving the construction of an activated sludge plant, consisting of an aerated lagoon serviced by four 75 hp surface aerators and a 120-ft. diameter clarifier incorporating sludge return. The new facilities which are to be in operation by June 1971 will be capable of treating three million gallons of wastes daily with an effluent discharge to Lake Erie.

An application from The Ontario-Minnesota Pulp and Paper Company Limited exemplifies the co-operative effort required between industry, consulting engineers, and municipal and government agencies, if suitable waste treatment programs are to be developed. Commission technical staff met with the company on several occasions prior to the formulation of detailed plans for the construction of a new kraft mill adjacent to the company's present mill site in Fort Frances, to determine the degree of treatment required to prevent contamination of the Rainy River.

The company proposed maximum use of in-plant controls by re-using water and saving fibre and chemicals in

order to reduce the mill waste flow and loading. In addition, the company's proposal included neutralization and equalization of all wastes in a mixing chest, pumping the wastes approximately one mile to the treatment works consisting of primary settling ponds followed by a five-day aerated lagoon serviced by six 75 hp surface aerators, returning the effluent to the plant to mix with existing mill effluent for discharge to the Rainy River through a special foam removal trap and a submerged diffuser outfall. Scheduled for completion by November 1971, the treatment system is estimated to cost the company \$3,158,000 and should produce an effluent meeting OWRC effluent requirements with respect to suspended solids, BOD, toxicity, taste and odour.



Following the Government's implementation of The Pollution Abatement Incentive Act, 1970, industries may now apply for grants equivalent to the amount of tax paid under The Retail Sales Tax Act on equipment used in the treatment of wastewaters. The responsibility for reviewing the applications and advising the Department of Energy and Resources Management on whether the purchased equipment qualifies for a grant, was given to the Design Approvals Branch.

TABLE 1

SUMMARY OF PROJECTS FOR 1970

	Items	Estimated Capital Cost
Applications Outstanding as of December 31, 1969	22	
Applications Received in 1970	174	
Total	196	
Details:		
Certificates of Approval issued	124	\$25,514,500
Applications Reviewed — Concurrence given	19	1,632,200
Sub-Total	143	\$27,146,700
Applications Reviewed — Approval not given	7	
Applications under review — or in abeyance as of December 31, 1970	46	9,066,400
Total	196	\$36,213,100
Project Meetings	219	
Public Hearings (OWRC Act, Section 32)	3	

TABLE 2

1970 CERTIFICATES ISSUED

Industrial Classification	Number of Certificates	Capital Cost
Basic Iron and Steel	2	25,000
Chemical	33	2,059,000
Food Processing	13	715,700
Metal Working, Plating and Finishing	11	673,000
Mining and Metallurgical	25	1,871,700
Miscellaneous Manufacturing	16	2,103,200
Petroleum	9	1,177,300
Pulp and Paper	6	6,502,300
Service	8	10,314,400
Textiles	1	72,900
	124	\$25,514,500

Industrial Wastes Analysis



(b) Special Projects

Specialty Chemicals

Because of growing concern regarding the potential threat to the aquatic environment from the use and disposal of a wide variety of specialty chemicals in industrial processes, a study has been initiated to attempt to quantify and identify these chemicals. Chemical suppliers and manufacturers are providing information on the active ingredients of the chemicals being used as well as any available information on environmental effects. Where possible, the potential effects of these chemicals on natural waters will be assessed.

Heavy Metals in Municipal Sewerage Systems

A study has been initiated into the quantities of heavy metals such as chromium, zinc, copper, cadmium and nickel that are present both in the raw sewage discharged to municipal sewage treatment works and in effluents from such works. Preliminary indications are that a large proportion of the heavy metals in raw sewage is removed by the treatment processes and is not discharged to receiving watercourses. The effects of accumulations of metals on specific sewage treatment processes and the effects of residual concentrations in effluents on receiving water quality are other aspects of the investigation.

Mercury Pollution

In the spring of 1970, the presence of mercury residues in certain species of fish caught in Lake St. Clair was confirmed and the export of commercial fish catches from this lake was immediately banned. Subsequently, several other watercourses in Ontario were shown to contain mercury-contaminated fish. Two principal industrial classifications involving direct discharge of mercury to natural watercourses in Ontario were identified. These were the caustic soda and chlor-

ine manufacturing plants using mercury cell electrolytic processes (chlor-alkali plants) and pulp and paper mills using organo-mercury compounds for slime control in processing equipment. Under Commission Orders, the six chlor-alkali plants in Ontario implemented measures to substantially eliminate mercury losses to the aquatic environment. Also, the usage of mercurial slimicides in the pulp and paper industry has been eliminated. Studies are continuing on the use of mercury in other areas such as in battery manufacture, in electrical switchgear and in instruments.

Polychlorinated Biphenyls

Polychlorinated biphenyls are a class of chlorinated hydrocarbons somewhat analogous to DDT in its effects on predatory fish and wildlife. These compounds have been manufactured in North America for nearly fifty years. Their properties are unique in that they are good dielectrics, have low vapour pressures, are chemically stable and very resistant to combustion. All of these properties are desirable in a wide variety of applications in electrical transformers, fire-resistant hydraulic fluids, heat transfer media and various adhesive, surface coating and caulking formulations.

At the present time, the degree to which polychlorinated biphenyl residues are present in fish and wildlife, in association with DDT, is not clear because of the wide variety of chemical species collectively identified as polychlorinated biphenyls and because of chemical similarities to DDT. Reliable quantitative analytical procedures to differentiate between polychlorinated biphenyls and DDT residues are now being developed and, therefore, much of the data reported on PCB residues in wildlife are open to question. The only major manufacturer of PCB in North America has withdrawn from the market those compounds known to be used in open systems where the compound

can ultimately be introduced into the environment. A reclaim service for the reprocessing of used material is offered by the manufacturer to those companies that use PCB in closed systems.

Rehabilitation of Mine Tailings Area

Representations made before the Deputy Ministers' Advisory Committee on Pollution Control were instrumental in the enactment of new legislation under "The Mining Act" which now requires rehabilitation, by means of revegetation or other means of stabilization, of abandoned mine tailings and plant areas. The OWRC is co-operating fully with the Department of Mines and Northern Affairs in this program since the measures undertaken will result in a reduction of water pollution from these areas.

Uranium, Mining, Milling and Refining Industry

The intensive industrial waste survey that was undertaken at the operating mines in the Elliot Lake district during the past three years have now been completed. In general, it was found that satisfactory control is being maintained over the discharge of radioactive contaminants from these properties; however, there is a problem with chemical contaminants. Recommendations to control the latter are being implemented and should result in a marked improvement in the chemical characteristics of the receiving waters in the area.

At the year's end, the uranium hexafluoride plant of Eldorado Nuclear Limited in Port Hope began continuous production. The Ad Hoc Safety Committee, comprised of federal and provincial regulatory officials, completed its safety assessment of this plant during the year and excellent co-operation was received from the company in fulfilling the requirements outlined by the Committee.

Mineral Resources Industry

In recognition of the water pollution problems being created by a rapidly expanding mineral resources industry in the Province, a staff member has been assigned on a full-time basis to specialize in problems associated with this industry and to co-ordinate the pollution control programs across the Province. Problems of immediate concern, and into which intensive investigations have been launched, include studies into acid mine waste drainage, and the use of mine-mill reagents. Other studies include the extent of water use and re-use within the industry, problems of wastewater recirculation, and the extent of tailings acreage in the Province.

Considerable assistance has been provided by the special projects staff in the review of waste treatment applications from mining companies. In this regard, a "Mineral Industries Information Sheet" was prepared to serve as an addendum to the standard application. This was received favourably by the industry and has resulted in accelerating the review of mine waste treatment applications.

Contingency Planning

Staff were instrumental in the development of the Lake Erie Contingency Plan which was issued during the year. This Plan outlines the response mechanisms and delineates the command functions in the event of a major spill of oil or hazardous substance in the Lake Erie drainage basin. A preliminary Province of Ontario Contingency Plan was developed and will be finalized early in 1971. The provincial plan outlines the functions of the various regulatory bodies which would become involved with major spills and provides a compatible framework for local contingency plans. To this end, numerous meetings were held with oil refinery groups, harbour commissions, bulk storage officials and municipal officials.



Industrial Pollution Control in Municipalities

The regulation of industrial waste discharges to municipal sewage systems is an important facet of the overall industrial waste control program that is being undertaken by municipal officials. To assist and guide municipalities in this area, information on sewer-use by-laws was forwarded to 23 municipalities, 11 proposed by-laws were reviewed and commented upon and three meetings were attended. Eleven enacted by-laws were received from municipalities during 1970.

The second industrial waste by-law enforcement course organized by staff again met with success. Sixty persons representing municipalities, industries and consulting engineers were in attendance. Plans are underway to conduct a similar course again in 1971.

The assessment of the effects of industrial wastes on sewage treatment plants being developed for municipalities under provincial financing is a continuing function of the Special Projects Group. As part of this function, 39 design reports were reviewed and 13 meetings were attended in 1970.

Canada-U.S. Working Group on Great Lakes Pollution

Staff were active in the sub-groups formed by the Canada-U. S. Working Group on Great Lakes Pollution to assess the recommendations of the forthcoming International Joint Commission Report on the lower Great Lakes. A staff member was appointed as the Canadian Co-Chairman of the sub-group to report on Pollutant Materials — Handling Hazards on Land. Staff were also represented on the sub-groups concerned with Water Quality Objectives, Contingency Planning, Pollutant Materials — Handling Hazards on Water, and Co-ordination of Action to meet Special Situations.

Division of Laboratories

J. H. Neil, Director

The Division of Laboratories is responsible for the analysis of chemical, bacteriological and biological samples arising from the investigative and control programs of the Commission's operating divisions. In addition to providing analytical support for the various Commission sampling programs throughout the year, laboratory staff also carried out field programs of a specialized nature to investigate a variety of environmental problems. The scientific staff continued to take an increasingly active part in field operations in support of the intensive survey work of other divisions. During 1970, mobile laboratories, staffed by scientists from the various disciplines, operated in Uxbridge to investigate an industrial waste discharge, along the St. Clair River as headquarters for the mercury program in that area, and in the Muskoka area and along the shores of the Lower Great Lakes and inter-connecting channels to analyze perishable bacteriological samples.

The Division operates two regional laboratories, one in London and the other in Thunder Bay. Staff at these laboratories handled local routine water and pollution analyses and also carried out biological field studies in the two regions. Plans were made during the year for combining the administrative and laboratory groups in London, currently operating from different locations, into an integrated office-laboratory complex in that city. Planning was resumed for a new laboratory wing at the Toronto laboratory; construction is scheduled for 1971 pending Treasury Board approval.

The existence of widespread mercury pollution in various areas of the Province came to light during the year, and a crash program was undertaken to develop an analytical method capable of measuring trace amounts of this metal. The laboratory was in the forefront in developing an effective modification of an existing instrumental technique. In

excess of 6,000 mercury analyses were carried out in support of the Commission's investigation of this problem.

A growing interest on the part of the public in matters concerning the environment resulted in many requests for visits to the laboratory. During 1970, 40 lectures, tours and conferences were handled by Division staff. Included in the visiting groups were science teachers, post-graduate university students on field trips, and members of professional and industrial associations.

The scientific staff, in addition to their regular laboratory assignments, were involved in a broad range of formal committee work, dealing with various aspects of water supply and pollution control activities. The Ontario Herbicide Committee, the Federal-Provincial Committee on Loans to Fishermen Affected by Mercury Pollution, and the Lake Michigan Interstate Pesticides Committee were some of the more important committees on which the laboratory scientific staff were represented.

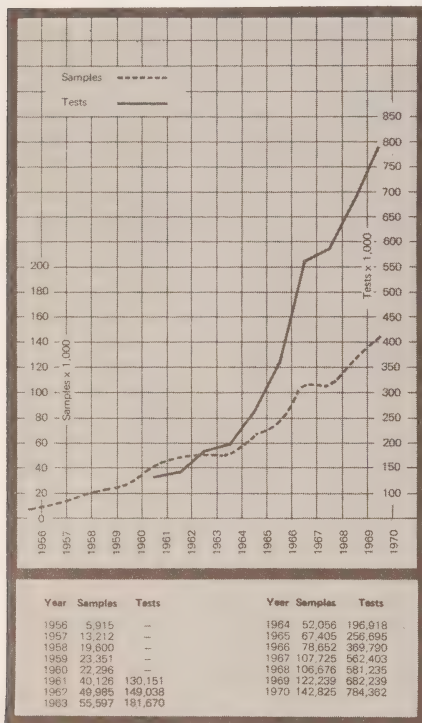
An increase of approximately 15 percent in both samples and tests occurred during the year. Table I and Figures I and II indicate in some detail the sources and types of samples processed and tests performed.

TABLE 1			
NUMBER OF SAMPLES			
	1969	1970	% Increase
Bacteriology	47,151	53,791	+ 14
Biology	6,127	11,168	+ 82
Chemistry I & II	68,961	77,866	+ 13
TOTAL	122,239	142,825	+ 16.8
NUMBER OF TESTS			
	1969	1970	% Increase
Bacteriology	154,021	204,964	+ 33
Biology	11,436	19,580	+70
Chemistry I	463,557	495,040	+ 6
Chemistry II	53,325	64,778	+ 21
TOTAL	682,339	784,362	+ 14.9

SUMMARY OF SAMPLE SOURCES

OWRC Divisions	Bacteriology	Chemistry	Biology	Total	%
Sanitary Engineering	21,985	23,858	48	45,891	31.8
Plant Operations	9,868	9,277	12	19,157	13.5
Research	406	9,916	272	10,594	7.5
Industrial Wastes	170	4,730	22	4,922	3.5
Laboratories	494	12,370	4,580	17,444	12.4
Water Resources & Others	867	1,569	122	2,468	1.6
OWRC Sub-Total	33,790	61,720	5,056	100,566	70.3
Non-OWRC Agencies					
Ontario Gov't Agencies	744	3,101	5,191	9,036	6.5
Federal Gov't Agencies	282	690	1	973	0.8
Municipal Agencies	17,818	9,519	853	28,190	19.8
Commercial Agencies	833	1,856	2	2,691	1.7
Private & Misc.	324	980	65	1,369	0.9
Non-OWRC Sub-Total	20,001	16,146	6,112	42,259	29.7
TOTAL	53,791	77,866	11,168	142,825	100.0

Fig. 1
Annual Samples Received and the Number of Tests Performed. (1956-1970)



BACTERIOLOGY BRANCH

The remarkably large increase in tests performed over previous years was a notable feature of the Branch's activities during 1970. Two hundred and four thousand tests were carried out, an increase of 50,000 compared to 1969.

The Branch devoted considerable time to developing improved methods for statistical evaluations of data. Computer programs were developed by staff as part of the continuing program to refine techniques for interpreting data.

Mobile laboratories continued to play a major role in survey programs, facilitating immediate analysis of perishable samples.

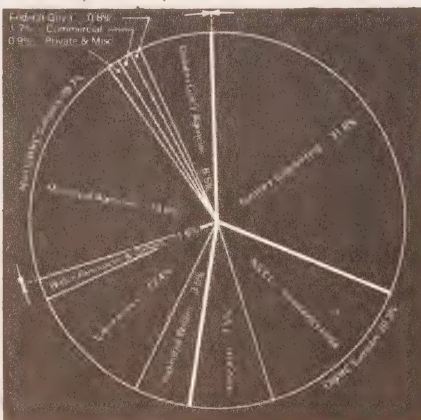
Tables II and III and Figure III indicate sources, types and the yearly growth rate of sample submissions.

River Section

A report was prepared on the 1968 and 1969 Ottawa River Survey.

Samples were taken of surface waters and tailings in areas influenced by uranium mine wastes at Elliot Lake. Far northern Lakes were sampled to establish the base level of bacteria in these waters. Hotel lagoons in the Muskoka area were investigated to define the public health hazard involved in spraying these lagoon effluents on golf courses or fields. Samples were analyzed from a sulphuric acid spill at the Serpent River.

Fig. 2
Summary of Sample Sources



An investigation, in co-operation with staff of the Water Quality Surveys Branch, was conducted on the Rideau and Ottawa rivers to assess the water quality and the effect of sewer and drain discharges. A report on the bath-

ing water quality at the major beaches in the Ottawa City area, based on 1970 data as well as on prior data, was prepared.

A summary report was prepared on the 1969 analyses of sediments and water from Rainy River. The report dealt with sulphur organisms and ammonia oxidizers associated with pulp and paper mill and domestic wastes entering the River.

A reported cattle kill in the Ringwood area, attributed to polluted water, was investigated and found to have resulted from poisoning by blue-green algae. Spencer Creek bacteriological data were reviewed and interpreted. The new Clairville Conservation area beaches were surveyed at the request of the Metropolitan Toronto Conservation Authority, and a special sampling program was arranged. Surveys were undertaken to assess the quality of the East River and Huntsville area waters; data were collected prior to the start-up of the Kimberly-Clark plant in order to determine the future effects of the plant's discharge on the receiving waters.

Water Section

A report on membrane filter and presence-absence bacteriological tests was prepared, based on raw and treated water data from 80 municipalities. A ranking system was adopted which permitted water quality comparisons among the municipalities, based on the degree of bacterial pollution observed. Quarterly reports were distributed which summarized bacteriological results for the preceding three months.

Staff from the regional laboratories were periodically recalled to the main laboratory to review analytical procedures. During the summer, both the London and Thunder Bay regional laboratories began reporting results of presence-absence tests to those municipalities served by the regional laboratories.

A study was made of three MF media for the detection and enumeration of coliform bacteria.

Taxonomy Section

Laboratory work on the classification and identification of bacterial isolates from the Midland, Penetang and Port McNicoll Bays Survey, conducted in the summer of 1969, was completed and a report prepared. The data were evaluated according to the new recreational water criteria published in 1970.

Plans for a survey of the Muskoka Lakes of differing trophic levels were initiated. Prior data collected from the Muskoka Lakes were reviewed. Arising from the survey, the primary identification tests of 2,500 isolates were completed. The secondary identification tests for the Enterobacteriaceae (1,200 cultures) were begun and continued throughout the year. A new commercial testing scheme for the Enterobacteriaceae was employed. Comparisons of biochemical results and an estimate of time-cost savings were initiated. A report was scheduled for completion by April 1971.

Short-term projects were also undertaken. The effects of environmental pH and temperature on the isolation frequency of genera from the Humber River were determined. Mandel's media, previously thought to be selective and enriching for members of the genus *Acinetobacter*, was evaluated and a report was prepared.

An identification scheme for aquatic *Streptococci* (fecal streptococci) was developed. The experimental scheme was employed on specific samples and resulted in cultures being successfully classified. A modified alternative classification was later employed. The new scheme produced reliable data, but further scheme modifications are needed.

Special Projects

As a result of recommendations brought forth by the government task force on Ontario recreational lakes, a special program was undertaken to investigate problems associated with these lakes. Staff co-operated with other divisions in planning and implementing this program, and over 4,000 samples were taken and analyzed. Lakes surveyed included Stony, Clear and Lovesick lakes, Cameron, Balsam and Sparrow lakes (all on the Trent Canal System), Bass, Riley, Six Mile, Otter and Kushog lakes, Jack and Steenburg lakes and Big Rideau and Lower Beverley lakes.

During the month of August, use was made of the facilities of the Thunder Bay regional laboratory and a mobile laboratory for an intensive survey of the Kaministiquia (Kam) River and Thunder Bay in conjunction with the Water Quality Surveys Branch. In the Kam River survey, each station was sampled at four-hour intervals for three days. The Thunder Bay stations were sampled four to six times in a three-week period. A report is being prepared. Regular monitor surveys were run on Lake Ontario (3 monitors), Lake Erie (2 monitors) and Georgian Bay and on the St. Mary's, St. Clair, Detroit, Niagara and St. Lawrence rivers. Where possible, mobile laboratory facilities were used, so that perishable samples could be analyzed quickly. All samples were analyzed, on a routine basis, for total coliform, fecal coliform and fecal streptococcus organisms.

Throughout the year, considerable time was spent on computer analyses and statistical evaluations of data. The Midland, Penetang and Port McNicoll Bays Survey data (bacteriological, biological, chemical and physical) were evaluated by both classical and experimental statistical methods, using computer programs.

Statistical analyses, by means of computer programs, were initiated for

TABLE 2

COMPARISON OF SAMPLE AND TEST STATISTICS FOR 1968 TO 1970

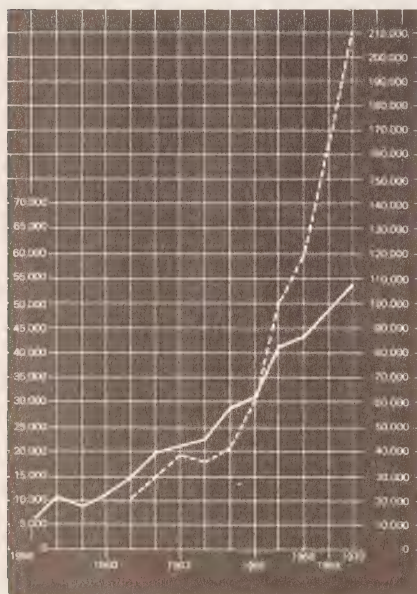
Major Categories	1968	1969	1970
Drinking Water Samples	24,764	25,641	29,063
Surface Water Samples	16,070	18,375	19,407
Sewage and Waste Samples	2,867	3,034	5,209
Miscellaneous Samples	157	101	112
Total Samples	43,858	47,151	53,791
Total Determinations	121,040	154,021	204,964
Other Groupings			
Great Lakes Samples	7,519	8,430	6,239
Recreational W.P.C.P.	—	—	4,058
London Lab Regional Samples	3,469	3,461	7,482
Thunder Bay Regional Samples	—	961	3,469
Mobile Lab Samples	—	—	5,557
Samples Unsuitable for Analyses	156	248	1,163

basic data collected during the 1970 recreational water pollution control program survey of the Kawartha Lakes. An efficient data analysis system was developed and tested. Evaluation of the system is continuing.

Discussions were held with bacteriologists of the Department of National Health and Welfare in response to a request for data analysis. Primary evaluations of data and experimental

design and plans for meaningful representations of data were made. A statistical analysis of data determining the relative reliability of visual counting methods was recently completed.

Fig. 3
Samples and Determinations from 1956 to 1970



BIOLOGY BRANCH

The various activities of the Biology Branch were consolidated into three sections during 1970, each with a biologist-in-charge to allow for improved delegation of responsibility at the sub-supervisory level. The internal structure now includes — Regional Biol-

TABLE 3

SAMPLE DISTRIBUTION ACCORDING TO SOURCES

Collected by OWRC Staff	1969	1970
Sanitary Engineering	19,704	21,985
Plant Operations	7,911	9,868
Research	103	406
Industrial Wastes	12	170
Laboratories	1,305	494
Water Resources	148	777
Others	7	90
OWRC total	29,190	33,790

Collected by Others

Municipal Agencies	15,515	16,929
Ontario Government Agencies	1,088	1,633
Private	370	284
Others	988	1,155
Total	17,961	20,001
ANNUAL TOTAL	47,151	53,791

ogy Section, Phytoplankton and Eutrophication Section, and Toxicity and Pesticides Section. Division responsibilities for biological programs is arranged between the regional biologists and the biologist-in-charge of the appropriate centralized section, depending on the emphasis of a particular survey effort. Increased attention was devoted to developing suitable approaches for biological survey work within the scope of major river basin surveys, undertaken to define water use plans and related pollution control requirements on a watershed basis.

Regional Surveys

Biological evaluations of water quality were completed, both for de-

tailed watershed surveys and on a spot check and surveillance basis, to evaluate specific pollution sources and to ensure that pollution control facilities were operating satisfactorily.

Major survey efforts included a pre-operational evaluation of the Big East River and downstream Lake Vernon, carried out to document background conditions prior to commencement of operations of a tissue mill, developed by Kimberly-Clark of Canada Ltd., north of Huntsville. Detailed chemical analyses of rainfall and snow samples were completed along with biological evaluations of lakes in the Sudbury District, in order to evaluate potential effects of reduced pH and heavy metal contamination associated with smelter fume fallout from mine smelting operations. Biological work on the Kapuskasing River was designed to determine the effects on aquatic production of pulp and paper mill wastes discharged at Kapuskasing and to acquire fish, waterfowl and sediment samples for mercury analyses. Detailed survey operations were completed on the Manitouwadge Lake Chain to assess the impact of base metal operations on lakes throughout the system, downstream of the Manitouwadge mining development.

Biological evaluations, of a somewhat narrower scope, were carried out on Spencer Creek near Hamilton, the Thames River near St. Mary's, Lake Erie at Nanticoke, Lake Huron at Douglas Point and Kempenfelt Bay of Lake Simcoe. Surveys, relating to mining activities, were carried out at Bruce and Pakwash Lakes, Atikwa Lake, Kenogamisis Lake, Confederation Lake, the Matawin River and Sturgeon Lake, all in north-western Ontario. Other surveys were completed on Butler Creek at Brockville, Lake St. John near Orillia, the St. Lawrence River at Maitland and between Brockville and Prescott, the Speed-Eramosa watershed and Canagagie Creek.

In co-operation with the Department of Lands and Forests, studies were made of the utilization by waterfowl of industrial ponding areas along the St. Clair River.

Pollution evaluation or pre-operational survey reports were completed in connection with investigations of Jackfish Bay of Lake Superior, Lake Erie in the vicinity of Nanticoke, the Serpent River Basin and the Tetapaga River near Temagami. At the year's end, additional reports were nearing completion for the Niagara River, the Ottawa River Basin, Peninsula Harbour of Lake Superior, the Penetang-Midland-Port McNicoll area of Georgian Bay, Kempenfelt Bay, Atikwa Lake and for a survey of algal conditions along the shoreline of Pelee Island.

Phytoplankton and Eutrophication

The principal effort in this section during 1970 related to the completion of a two-year survey of the Muskoka Lakes system which involved the development of a nutrient budget and an appraisal of the relative significance of various nutrient sources — including cottage inputs, municipal waste dis-

charges and watershed runoff. A questionnaire survey was undertaken to obtain information on cottagers' activities which might influence water quality. The significance of various nutrients was assessed by algal bioassays carried out in the laboratory and in plastic bags immersed in the lake. Physical, chemical and biological characteristics of the entire system were studied in detail.

Studies were carried out, in co-operation with the Research Branch of the Department of Lands and Forests, in which the ecology of farm ponds was investigated to permit assessments of relationships between aquatic plant and fish production.

Surveys to assess the status of eutrophication were completed on Roblin Lake, Barry's Bay, Clear Lake, Leonard Lake, Silver Lake and Brighton Bay. The suitability of Roblin Lake and Barry's Bay as municipal water supply sources was considered in the studies pertaining to these waters.

Reports prepared by this section included the 'Status of Enrichment of Silver Lake', 'Phytoplankton Conditions in Mooney's Bay and Dow's Lake' and a 'Water Quality Evaluation of Bernard Lake'. A paper entitled 'A Case of Nu-

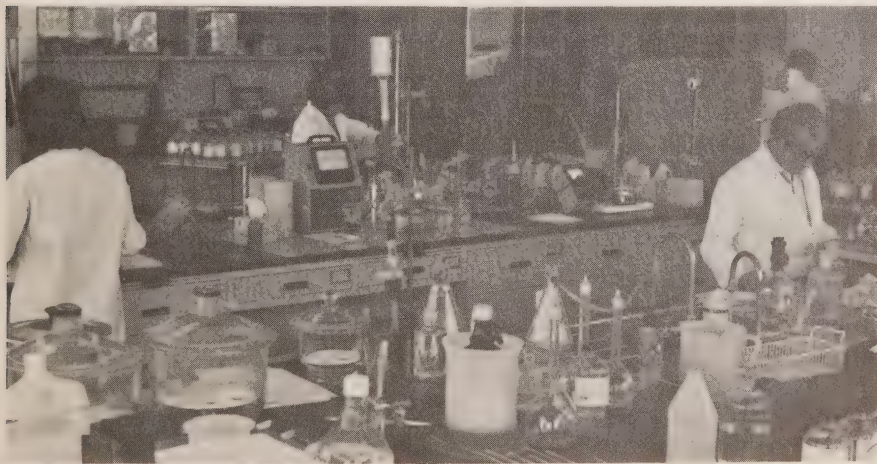
trient Enrichment In An Inshore Area of Georgian Bay' was prepared for presentation at the 14th Conference of the International Association For Great Lakes Research'.

The seventh annual Algae Identification and Enumeration Course was held at the laboratory, which involved representatives from eight municipalities. Visits to water treatment plants were made throughout the year to assist co-operators in the Provincial Algae Counting Program with respect to phytoplankton identification techniques. A fifth edition of the Algae Counters' Review was prepared and distributed to co-operators and the municipal personnel involved in identification and enumeration programs.

Toxicity and Pesticides

Evaluations pertaining to the effects of mercury on fish constituted the salient features of the work of this section during the year. Monitoring of mercury in fish from selected waters across the Province was carried out in co-operation with the Department of Lands and Forests. Emphasis was placed on situations where industrial activity constituted a potential source of mercury pollution. Selective samples of fish were obtained from a number of critical areas to allow comparative evaluations of mercury concentrations in future years.

Industrial waste bioassays were completed on effluents from the Shell Oil Refinery at Sarnia and the E. B. Eddy Company at Espanola. At this latter industry, assistance was provided to plant personnel in establishing bioassay monitoring as a routine control measure on effluent quality. A number of dispersants were evaluated to demonstrate which of these compounds afforded the least hazard to aquatic biota when used in control operations for accidental oil spills. Conditions along the Porcupine River were evaluated to ascertain the combined impact of



municipal and mine waste discharges. Assistance in developing necessary criteria for mine wastes reaching the Porcupine system was provided to the Division of Industrial Wastes.

A mobile bioassay unit was developed to undertake on-site bioassay and toxicity studies at industrial locations. The unit was first put to test in an evaluation of waste discharges from Comco Plating at Uxbridge. It was then transferred to the St. Clair River to serve as a headquarters for the mercury program in that area. Throughout the latter part of the winter, following the return of the unit to Toronto, progress was made in improving the sophistication of its interior design and equipment for work to be completed in 1971.

Fish collected in Thunder Bay and nearby Grand Portage Bay (Michigan) were subjected to flavour evaluation tests to ascertain the significance of pulp and paper mill discharges in contributing to fish tainting problems. Clear evidence of reduced market quality of commercial fish species was demonstrated as a result of this effort.

A number of programs relating to assessments of pesticides were carried out during the year. Pesticide use throughout the Big Creek watershed was investigated and a more specific effort was directed towards evaluating the impact of aerial applications of "thiodan" to tobacco crops on aquatic production in adjacent streams.

Aquatic plant and algae control studies were undertaken on a number of ponds and lakes. The herbicide "bromacil" was tested for vegetation control in the Trent Canal system and a report was issued outlining the results achieved. Degradation rates of this chemical in water and sediments were established by periodic sampling following the treatment. The efficacy of "patoran" was tested in farm ponds and a 30-acre lake was treated with "diuron" for control of blue-green algae. Reports were completed on the screening of herbicidal

compounds in plastic enclosures, on the efficacy of several compounds for controlling water lilies and on the use of TOK Granular for aquatic plant and algae control. An investigation of cattle mortalities near Uxbridge demonstrated that ingestion of water containing the blue-green alga *Microcystis* was responsible. The pond containing the algae was treated with copper sulphate to bring the problem under control.

Proposed mosquito control operations in the Municipality of Ottawa-Carleton and in the Township of Mara were turned down because adequate planning was not incorporated to ensure the safety of the aquatic environment. Trapping of adult mosquitoes was carried out at the Township of Mara to provide a basis for the evaluation of the benefits to be derived from proposed mosquito larviciding operations in 1971.

Clams were caged at five locations throughout the Muskoka Lake system to compare DDT uptake. This effort will provide a baseline to measure future changes in DDT concentrations, now that the use of this insecticide has been curtailed in vacation areas.

Based on earlier studies, printed information was prepared on "Swimmers' Itch, its Biology and Control". This information is made available to cottagers and tourist operators who experience swimmers' itch problems and who wish to learn how the severity of this troublesome condition can be substantially reduced.

Biology staff contributed to a number of important educational programs throughout the year. A lecture on the "Significance of Sewage Plant Effluents on Streams" was delivered at a course offered to sewage works operators. An address on "Why Nutrient Removal?" was delivered at the Senior Waterworks Operators Course as part of a familiarization program dealing with this new phase in the development of pollution control facilities. Four members of staff participated in "Survival

70", a seminar on environmental pollution held simultaneously at community colleges throughout Ontario. Staff participated at a Junior Conservation School, sponsored by the Ontario Federation of Anglers and Hunters. Displays were set up at the Sports and Hobby Show held at Gravenhurst, in conjunction with the Muskoka Cavalcade of Colour, and at the annual meeting of the Muskoka Tourist Association to illustrate the nature of recreational lake studies in the Muskoka area. A lecture on "Teaching Ecology to Students" was presented to 70 members of the Metropolitan Toronto Science Teachers Association.

Several technical papers were delivered at various conferences dealing with the biological aspects of water management. A paper was presented at the Midwest Benthological Society dealing with the use of benthic faunal parameters for measuring water quality. "Cottagers and Water Pollution" was the topic of a paper presented at the first annual meeting of the Ontario Section of the Canadian Institute on Pollution Control. A paper entitled "Status of Aquatic Pollution and Its Control" was delivered at the annual meeting of the Canadian Committee of Fishery and Wildlife Biologists and an address on "The Biological Evaluation of Water Quality" was given at a joint meeting of the Chemical Institute of Canada and the American Chemical Society.

The number of permits issued to authorize the use of aquatic nuisance control agents in 1970 reached 239, an increase of 20 over 1969. The breakdown with respect to permits issued is as follows:

Aquatic Plants and Algae Control	218
Mosquito and Blackfly Larviciding	9
Coarse Fish Control	11
Fish Disease Control	1
Total	239

Approximately 850 enquiries were answered on regulatory practices and

permissible control techniques. A member of the Branch continued to act as an aquatic specialist on the Ontario Herbicide Committee and summarized the information used in the aquatic section of the annual publication of the National Weed Committee.

A total of 48 fish kills were reported for the year. Causes of these mortalities were as follows:

Oxygen depletion	5
Industrial Wastes	7
Pesticides	2
Winterkill	9
Other Natural Causes	11
Cause not identified	5
Miscellaneous	2
Unconfirmed	7
Total	48

An estimated 40,000 fish were involved in the aforementioned mortalities, in addition to substantial die-offs, involving thousands of alewives in western Lake Ontario, associated with rapidly changing temperature conditions.

A breakdown of the samples received and determinations completed throughout the year is provided in Table IV below.

CHEMISTRY I BRANCH

The resources of Chemistry I Branch were fully utilized throughout the year in processing a record number of samples and tests. Figure IV indicates the sources of samples received for chemical analysis during the year. Figure V provides the analytical determinations carried out by the particular laboratory sections in the Chemistry I Branch. The regional laboratories in London and Thunder Bay doubled their test output of the previous year and continued to play an important role in handling routine regional analytical requirements.

Considerable time and resources were devoted to development work on analytical methods. Methods for determining iron, fluoride and suspended

TABLE 4
SUMMARY

	Samples Received		Tests Performed	
	1969	1970	1969	1970
Algae Counts	2,686	2,319	1,530	1,222
Algae identifications	104	150	117	131
Threshold odours	105	106	102	2,852
Algae bioassay	30	10	893	12
Toxicity bioassay	85	76	5,025	4,716
Pesticide analyses	392	35	488	67
Zooplankton	511	228	31	66
Bottom fauna	1,587	1,340	2,597	423
Plant identifications	65	33	19	14
Taste tests (fish)	21	—	—	360
Diatom slides	218	164	573	1,038
Diatom counts	—	—	18	272
Fish identifications	91	923	43	315
Sediments	232	450	—	34
Algal bioassays	—	2	—	1,985
Mercury sample preparations	—	5,280	—	5,155
Species diversity counts	—	—	—	121
Miscellaneous	—	52	—	797
TOTAL	6,127	11,168	11,436	19,580

solids were among those revised and confirmed. Of note in the impending 13th Edition of "Standard Methods" is the inclusion of glass fibre filters as an approved medium for determining suspended solids. These filters were evaluated and adopted some nine years ago in the OWRC laboratory. Evaluation of new instrumentation for turbidity analysis neared completion, methods for the analysis of calcium and magnesium on the Atomic Absorption Spectrophotometer were developed, refine-

ments were introduced in the automatic analysis procedures for nutrients, and evaluations were started on a new automatic analyzer capable of greater productivity than the existing Auto-Analyzer, on an improved conductivity meter, and on membrane probe dissolved oxygen meters.

Staff members participated in planning the analytical aspects of a number of surveys and interpreting the findings. Using this approach, contributions were made to the Recreational Area Water Pollution Control Program, the Northern Ontario Water Resources Studies, the Muskoka Lakes Eutrophication Studies, and the Aquatic Plant Ecology Studies.

Several technical papers were prepared for presentation at conferences or publication in scientific journals. Staff prepared a summary of the present status of the Branch's sediment analyses, for circulation within the OWRC, and a compilation of "Outlines of Analytical Methods" for the same purpose. The sediment analysis project is a continuing methods development program in support of new sampling approaches undertaken by a number of divisions, aimed at defining the relations between submerged sediments and overlying water quality. Work was also done for the Biology Branch on the analysis of aquatic vegetation.

Staff provided laboratory training in analytical procedures for analysts from regulatory, industrial and municipal agencies.

Great Lakes Laboratories

The Division of Laboratories utilized the London regional laboratory and a special section of the Toronto laboratory to speedily analyze perishable samples taken in conjunction with the Commission's Great Lakes Program.

Sample freezing procedures continued to be used as a means of minimizing the rate of decomposition of sample constituents. A study was car-

ried out to assess the effects of storage on sample constituents held in plastic and glass bottles at different temperatures. The results indicated that the freezing procedures, currently used, are satisfactory. An investigation into sources of contamination in the phenol analytical method was completed.

All of the data associated with the Great Lakes Program were reported in a format suitable for computer storage and retrieval.

Regional Laboratories

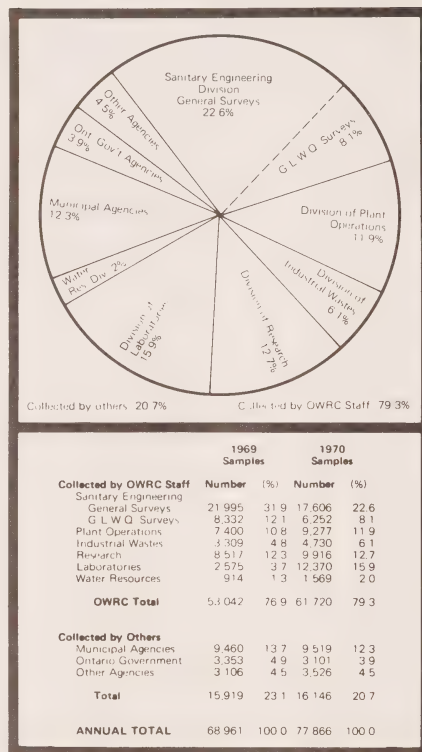
The London field laboratory continued to fulfil a useful role in handling samples from the London region which otherwise would have required shipment to Toronto for analysis. The number of regional samples received totalled 5,260, a 32.7 percent increase over 1969. Tests performed amounted to 38,456, a 92 percent increase over 1969.

The Thunder Bay regional laboratory continued to maintain a steady rate of growth with respect to samples submitted and tests performed. During the year, 3,861 samples were received, requiring 24,401 tests. Comparative figures for the previous year were 1,309 and 12,140 respectively.

Throughout the year, staff assisted personnel of the Systems and EDP Branch in preparing material for inclusion in a report on an Automated Laboratory Data Handling System.

A continuing analytical Quality Control Program was carried out during the year. Standard reference samples were prepared regularly and distributed to all the OWRC laboratories for analysis. In addition, the laboratory participated in Reference Sample Programs organized by American agencies. Staff were recalled from the regional laboratories to undergo refresher training programs in the main laboratory in order to ensure that the latest modifications in analytical procedures were being uniformly applied throughout the Commission laboratories.

Fig. 4
Summary of Chemical Sample Sources



CHEMISTRY II BRANCH

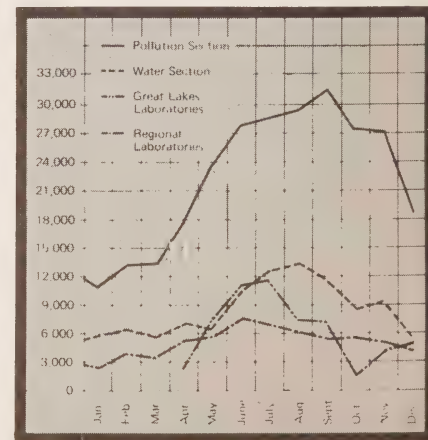
The year 1970 was marked by an increase in both output and efficiency. More than 64,000 tests were completed, which represents a 21 percent increase over the previous year. The increase resulted from normal expansion of existing programs and from the growing need to measure a broader variety of general environmental pollutants. Figure VI indicates the number of tests performed each month.

The serious side effects of pesticides on the environment made scientists

more alert to the possible hazards of persistent widely-used chemicals, originating from industrial, mining and agricultural sources. Two groups of such chemicals were recognized as being of utmost importance: the mercury compounds and the polychlorinated biphenyls. The mercury problem required the setting up of a special laboratory and assigning staff to a crash program of meticulous method development work to refine procedures capable of accurately measuring trace quantities of mercury.

Several hundred analyses were carried out in support of various court actions. The special handling of such samples and the complex analyses generally required placed an additional strain on the laboratory's facilities. During 1970, it also became evident that companies facing higher fines were willing to hire experts to question the validity of the prosecution's arguments. In order to cope with this challenge, the laboratory concentrated on developing additional sophisticated analytical techniques.

Fig. 5
Analytical Determinations — Chemistry I Branch



Inorganic Analysis

Heavy metals constituted the largest portion of tests completed. A noticeable increase in samples for sediment and fish analysis also occurred. Over 6,000 mercury tests were completed, along with thousands of unreported analyses used in the mercury method development. The mercury program required the services of almost half of the staff from the inorganic laboratory, and most of the other Commission sampling programs were curtailed to cope with this emergency.

Progress was made in refining techniques for measuring toxic metals such as lead, cadmium and arsenic. Ducks, several species of fish, and soil samples were analyzed for these elements. Background levels of heavy metals were established for species from remote unpolluted areas and compared to those collected from areas known to be associated with heavy industrial activity.

Another study of environmental interest concerned the effect of processed sewage on soil and on plants grown on sewage-treated soils. A correlation was found between the metals present in the sewage, and the uptake of these metals (notably chromium, copper, lead and zinc) by the plants.

The role of toxic metals in sewage treatment was investigated on samples from 20 WPCPs and involved thousands of analyses for a large number of heavy metals. Other projects undertaken were the stream dilution studies of the Water Quality Surveys Branch, requiring hundreds of lithium determinations; the arsenic investigation in the Moira Lake (Deloro) area; cyanides in mining wastes, and lead in lakes as a consequence of motor-boating.

Organic Analysis

The growing demand for routine organic tests accounted for the increased output of the organic laboratory. Around forty different tests are now done routinely. Phenols, ether ex-

tractables, chlorinated pesticides, oils, greases, polymers, paint pigments and hydrocarbons, in general, were the analyses most frequently requested. In addition to the basic separation methods and infra-red analysis, chromatographic methods were used to confirm the analytical results. With respect to oils, a method was developed to determine their sulphur content, and preliminary tests were carried out to determine various trace metals, the concentrations of which are characteristic of various oils of different origin. The phenol tests were thoroughly investigated, with a view to replacing the present method with an instrumental technique.

The investigation of organic micro-pollution in the lower Great Lakes System, using carbon filter techniques, neared completion. Carbon filter tech-

niques were also used to define specific industrial sources of pollution.

The carbon analyzer instrument was used extensively in a variety of studies. A specific technique was developed to measure sub-ppm concentrations, with a high degree of accuracy. The relationship between Biochemical Oxygen Demand, Chemical Oxygen Demand and Total Organic Carbon was investigated and was found to be fairly constant for plant effluents.

The discovery of mercury as a major pollutant created a need for a reliable method to measure trace levels of methylmercury in fish and water samples. A suitable method was developed, based on a modification of a Swedish procedure.

The widespread occurrence of polychlorinated biphenyls in the environment also created a need for an analyti-

Mercury Analysis



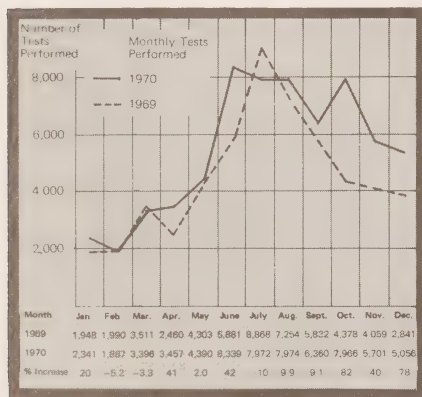
Division of Plant Operations

D. A. McTavish,
Director
C. W. Perry,
Assistant Director

identifying trace amounts of this compound. The laboratory developed a process which has proven to be reliable, although further refinements are required to improve sensitivity and to simplify the technique.

Members of staff attended scientific meetings, conferences and instrument demonstrations, and visited other laboratories for valuable exchanges of information. Many people from private and government organizations visited the laboratory, seeking advice on analytical methods and techniques.

Fig. 6
Analytical Determinations — Chemistry II
Branch

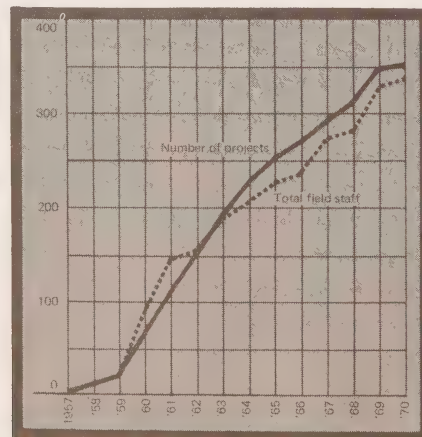


The Division of Plant Operations supervises the operation of all water and sewage works financed and constructed by the Commission. By the end of the year, there were 352 projects operating in 215 municipalities and 7 industries (municipal: 132 water, 191 sewage; provincial: 13 water, 16 sewage). A total of 340 plant operators were on staff at the year end. (See Figure I.)

ADMINISTRATION

The Division becomes involved in each new project during its design stages. Reports, plans and specifications submitted by consulting engineers are reviewed by the Division, in conjunction with other divisions, to ensure the provision of adequate works. The Division is also responsible for investigating and initiating enlargement of existing projects, where such enlargement is necessary. The Division has an involvement in the setting of rates for provincial works and also in the altering of the initial rates, when conditions warrant, within the terms of the initial agreement.

Fig. 1
Division of Plant Operations



For purposes of administration, the Province is divided into six regions, the projects in each region being the responsibility of a regional operations engineer. Major provincial projects are the responsibility of an Engineer-Manager. The operations engineer and the engineer-manager report to a supervisor, who, by participating in the development of the policies established at the divisional level, ensures a high standard of operation.

The operations engineers and engineer-managers prepare annual estimates of the project operating costs, determine staff requirements, and maintain liaison with local officials. They also ensure that adequate preventative maintenance of equipment is practised and that the plant process provides the maximum possible treatment. They are responsible for initiating expansion programs and for establishing and maintaining communication with present and prospective project participants, as well as with other provincial departments having an interest in the field of water and sewage treatment.

A maintenance section, consisting of mechanical, electrical and electronic engineers and technologists, assists the operations engineers and engineer-managers in establishing adequate maintenance programs. A project services section, including a statistical group, assists in process problems and maintains data on project operation.

PROJECT SERVICES SECTION

The project services section investigates operating field problems, evaluates operating results, appraises new chemicals and processes, reviews plans and specifications for certain new projects and prepares special reports for the Division. The project services engineer also supervises the activities of the Division's statistical and brochures section and acts as the Division's liaison officer with

the Commission's Systems and Electronic Data Processing Branch and the Information Centre.

During 1970, process and sampling statistics on all projects were maintained by the statistical section. The brochures section prepared copy material for 56 annual operating summaries, which were subsequently printed and distributed. In addition, the brochures section produces a general news bulletin and a maintenance bulletin for plant operators at regular intervals.

The project services section prepares and prints summary reports on the operation of water pollution control plants, water treatment plants and waste stabilization ponds operated by the Division. During 1970 the section provided training in laboratory techniques for field personnel at a number of plants and assisted in establishing new or improved laboratory facilities at several plants.

MAINTENANCE SECTION

High standards of maintenance and a preventative maintenance program ensure continuity of services at all water treatment and pollution control facilities and also protect the Commission's capital investments.

The technical services group, consisting of qualified technologists and technicians reporting to the Maintenance Engineer, provides a services function to the Division. This group is responsible for the continued development of the overall maintenance program and for assisting the operations staff in its implementation. The group's primary services include trouble shooting, planned repair, inspection, modification, contract maintenance supervision, engineering and training.

Project maintenance assistance and co-ordination of project preventative maintenance is provided by the regional maintenance technician who reports directly to the regional Operations Engineer.

Close liaison between the regional operations staff and the technical services group results in a province-wide standard but flexible maintenance program. A reporting system permits continuous evaluation of the maintenance program and offers the basic information required for the evaluation of equipment. This information, when correlated, provides data which is used in the selection of materials and equipment for new projects and the up-grading of existing treatment process equipment.

SAFETY SECTION

The safety section, consisting of two Safety Officers reporting to the supervisor of the technical services group makes routine inspections of all projects, looks into the safety aspects of the operation and ensures that the safety regulations are adhered to. The section investigates lost time accidents, provides training to operators, participates in training courses and arranges first-aid and fire-fighting drills.

The section maintains close liaison with the Department of Labour and its Safety and Technical Services Division and assists in the development of regulations relating to industrial safety and field safety.

Papers were presented during the year by the section to AWWA conferences and seminars.

There were no fatalities or permanent injuries suffered during 1970 by the Division's operating personnel. Disabling injuries, frequency rates and severity rates are compared for the years 1965 to 1970 in the following table:

Year	Disabling Injuries	Frequency Rate*	Severity Rate**
1965	13	33	351
1966	19	26	256
1967	9	17	260
1968	22	37	724
1969	18	29	496
1970	18	27	277

* Disabling injuries per million man-hours worked.

** Man-days charged to disabling injuries per million man-hours worked.

MAJOR PROVINCIAL WORKS

Lake Huron Water Supply System

The project comprises a treatment plant and a main pipeline with an ultimate capacity of 72 MGD. The present installed capacity of filtration and pumping equipment is 37 MGD. Branch pipelines serve the Village of Grand Bend and the Town of Parkhill. The Township of London and the City of London are on the main pipeline. The major consumer, the City of London, received 99.3 percent of the 8 billion gallons of water pumped. The earlier Agreement between the Commission and the City of London, which limited maximum flows to 27 MGD, was replaced by an undertaking by the Commission to supply the peak demands forecast three years ahead by the City. Negotiations for water supply to the townships of Stephen and Bosanquet and the Village of Ailsa Craig were proceeding at the end of the year.

Lake Erie Water Supply System

The system serves the City of St. Thomas and the Ford of Canada Automobile Assembly Plant at Talbotville. The operation of the St. Thomas Treat-

ment and Pumping Plant, which was purchased by the OWRC in 1969, was continued, with the Kettle Creek source being supplemented by raw water taken from the Lake Erie pipeline. The construction of the new Lake Erie Treatment Plant near Port Stanley was on schedule. The new plant will go into service in May, 1971. The purchase of larger pumps to supply treated water to the City of St. Thomas and the Township of Southwold was authorized by the Commission. Tenders were called for the construction of a 16-mile branch pipeline to the Village of Port Burwell and the townships of Yarmouth, Malahide and Bayham.

Both the Lake Huron Water Supply System and the Lake Erie Water Supply System are supervised by an Engineer-Manager located at the OWRC Regional Office, London.

South Peel County Water and Sewage System

The South Peel Water and Sewage System began operation in June 1969. The provincially-financed system amalgamated all existing municipal and OWRC water supply and sewage treatment facilities in the southern half of Peel County.

Municipalities within the South Peel System are the towns of Brampton, Mississauga, Port Credit, Streetsville and that part of the Township of Chingacousy south of No. 17 side road. A combined population of over 200,000 people is provided with a lake water supply and sewage treatment facilities by the system. During 1970, construction was underway for enlargement of the major water treatment plant to 48 MGD and the major water pollution control plant to 37 MGD, as well as on major water distribution, pumping, and storage facilities. Completion of these expansions is expected in late 1971.

Future planning for enlargement and the administration and operation of the system are the responsibility of an Engi-

neer-Manager and his staff located in the Town of Mississauga.

REGION I

Forty-three projects were in operation during 1970 in Region One. Seven are water plants and 14 are water pollution control plants. The balance of the projects are either water distribution systems or sewage collection systems. Fifty-eight new projects were at various stages of development as Provincial projects.

During the last quarter of the year, the Wallaceburg water pollution control plant began operation. In addition, the expansion of the Union Water System was completed. The construction of the Amherstburg Water System began late in the spring. The expected completion

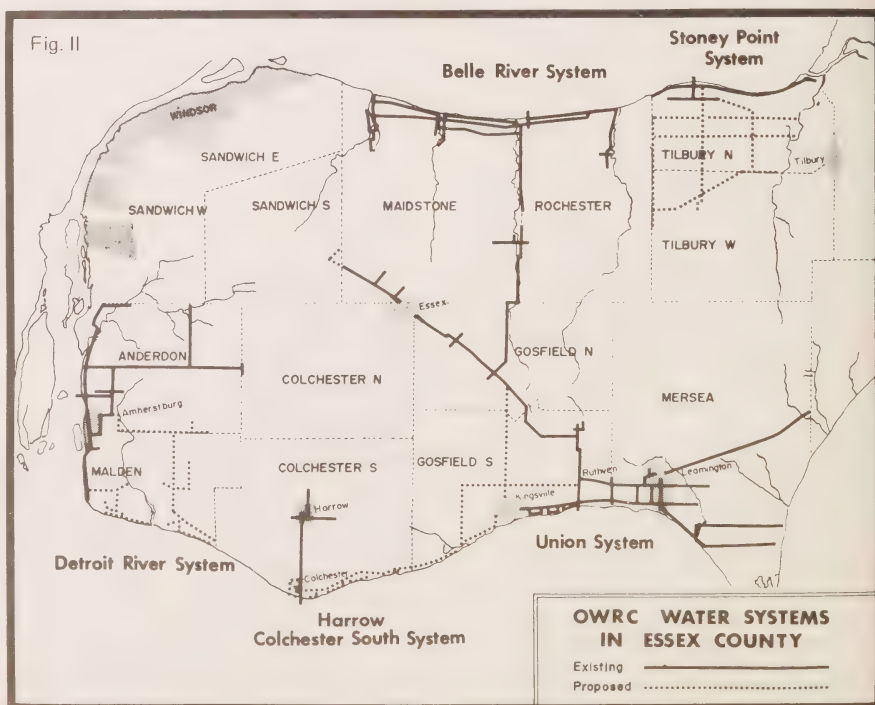
date for this project is the summer of 1971 which is approximately one year ahead of schedule.

In addition to developments in the Essex County water grid (see Figure II) further progress was made towards design of the West Lambton and Kent County water schemes. The initial stage of the Kent County system will be operable early in 1971.

REGION II

Forty-nine projects were in operation during 1970, fourteen of these being treatment facilities and the remainder being distribution or collection facilities.

Enlargement of the Burlington Skyway WPCP from 3.0 to 6.0 MGD was completed. Construction on the Rose-



mount pumping station project in Port Colborne and the Commission's first oxidation ditch at Cayuga were near completion at the year end.

The Regional Municipality of Niagara assumed operational responsibility for the OWRC-staffed projects and a few of the smaller municipally-operated OWRC projects in the Region on December 1, 1970.

At Brantford, the new method of sludge handling, by means of digested liquid sludge disposal on sludge fields, has proven to be very successful during the first eighteen months of operation. Previously, digested sludge was vacuum-filtered prior to land disposal. The total costs are approximately 65 percent of what they were when dewatering by vacuum filtration was included. It is anticipated that the 70-acre field available for this purpose will suffice for at least the next five years. Experiments to determine the fertilizer capability of the liquid sludge were initiated early in the year and will continue in 1971. A farmer who owns land adjacent to the sludge field has provided approximately twenty acres for this purpose. The crop production (field corn for cattle fodder) from this area is comparable to production from other areas of his farm which receive only commercial fertilizers. While crop yields were not determined in 1970, random sampling of corn ears indicated that the larger ones were grown in the sludge-fertilized area.

REGION III

The 40 projects in operation in 1970 consisted of 19 treatment facilities and 21 distribution or collection systems.

The facilities at the Georgetown, Fergus, Elora, Preston, Galt, Kitchener, Stratford, Goderich and Listowel projects are being expanded.

A phosphate removal program, using a ferrous-ferric chloride iron salt solution, began in November at the Preston WPCP. Results obtained for Novem-

ber and December proved this program to be very successful. In addition, a phosphate removal program, using lime, was conducted in Elmira. The results from this test were not conclusive.

Expansion studies, using polymers, at the Elora WPCP were conducted. Initial results obtained were very encouraging.

Expansion of the Goderich WTP filters was initiated. All necessary work will be done by OWRC staff.

Chlorine contact chamber retention and mixing studies, undertaken with staff of the Division of Research, were conducted at the Galt, Kitchener and Stratford WPCP's.

Composite sampling studies were conducted on all projects with waste stabilization ponds to accurately determine the organic loadings.

REGION IV

Seventy-seven projects were in operation during 1970. Of these, 27 were water and sewage treatment facilities, 12 were deep wells (several with distribution systems) and the remaining 38 were enlargements of existing systems or distribution-collection systems.

Provincial water and sewage systems became operational at Beeton and Emo.

During December, arrangements were made to staff and commence the operation of sewage systems at Meaford and Stayner early in 1971.

REGION V

There were 42 sewage and 33 water projects in operation in 1970. Regular supervision was provided on a full-time basis at 13 sewage projects and five water projects, and on a part-time basis at 14 sewage projects and 15 water projects. A large number of the projects were located in the vicinity of Highway No. 11, running north from Toronto to Moonbeam near Kapuskasing, and on Highway No. 17, running west from North Bay to Espanola.

Studies, design or construction related to future requirements were underway at 19 of the existing projects. A storm-flow equalizing tank was under construction in Richmond Hill and lime treatment facilities were being installed in Newmarket.

Part of the new Lake Timiskaming water and sewage projects in the Haileybury area were put into operation at the end of the year. The 1.5 MGD water treatment plant was under construction and water was being supplied from the existing Haileybury plant. An elevated water storage tank, which will eventually be part of the Blezard Valley System, was completed in the Township of Balfour.

Approximately 45 new water and sewage projects were under various stages of development. Considerable time was spent on reviewing these projects, particularly those associated with the Blezard Valley Scheme.

REGION VI

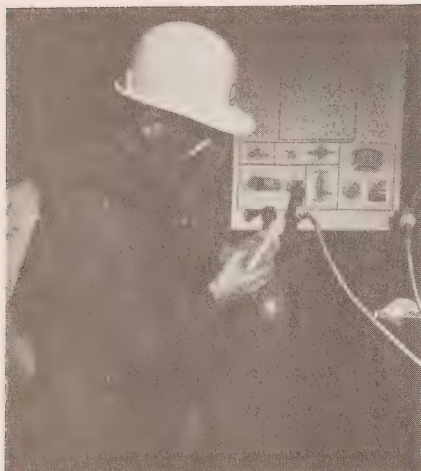
A total of 47 municipalities have now been provided with either water or sewage services. These facilities consist of the following:

- 9 waste stabilization ponds
- 12 small water distribution systems with a well water source
- 6 small water distribution systems with a surface water source
- 3 activated sludge sewage treatment plants
- 4 primary treatment plants
- 1 trickling filter plant

There were 10 projects under construction during the year. Three of these projects were completed before the end of the year; the remaining seven projects are scheduled for completion in 1971. Eight of the ten projects are provincially-financed and the remaining two are OWRC/municipally-financed. The Belleville primary treatment plant was taken over as a provincially-financed plant and construction commenced on

Division of Project Development

P. G. Cockburn, Director
L. F. Pitura, Assistant Director



Safety Program

its enlargement to an 8 MGD activated sludge plant. Four additional projects were ready for tendering by the end of the year.

There were eight OWRC/municipally-financed projects that required enlargement. Seven design reports for the enlargement of these projects were completed by December.

The treatment plant located in Cornwall is the first provincially-financed sewage project in the Province. It appears that there may be many more provincially-financed projects in this area in the future.

In the latter part of 1970, the Belleville/Trenton public water and sewage area was established under Section 46(a) of the OWRC Act. An Advisory Board was set up but, since the project is only in the formative stages, only one meeting of the Board was held.

The Division of Project Development is responsible for the development of OWRC-financed water and sewage works systems under sections 16(a), 16(1) (d) and 39 of the OWRC Act. Details concerning the responsibilities and activities of the various branches are presented later in this report.

During the year, there were several significant developments that affected the functions of the Division and the highlights of these are summarized below:

(A) ASSISTANCE TO SMALL MUNICIPALITIES

The announcement, late in 1969, by the Government of Ontario of a system of financial assistance to small municipalities continued to have an accelerating effect on the development of a large number of projects. As a result of this assistance program, the Commission has been more successful in obtaining acceptance of the financing proposals with respect to water and sewage projects, and municipalities have shown a greater willingness to proceed with the development of the required works. The same results have been experienced in the processing of applications through the Ontario Municipal Board; several projects, which previously would have been delayed, reduced in scope or postponed indefinitely, have continued to advance, primarily due to the assistance available under this program.

The assistance program was modified to some degree in 1970 when approval was received from the Treasury Board for such assistance to be made applicable, as well, to projects where extensions of existing facilities were required. It is expected that this modification will increase the number of municipalities eligible for assistance.

(B) REGIONAL MUNICIPALITY OF NIAGARA

The establishment of the Regional

Municipality of Niagara in 1970 resulted in a change in the Commission's basic concept with respect to assisting municipalities in the provision of water and sewage works. Whereas, previously, the Commission dealt with individual municipalities in the area on water and sewage treatment requirements, it now deals directly with the Regional Municipality. A Technical Advisory Committee, consisting of Commission staff and staff of the Regional Municipality, has been organized for the purpose of providing close liaison between the two organizations in the development of overall sewage and water works programs. At the end of the year, the Regional Municipality assumed the responsibility for the operation of the major existing facilities. In addition, discussions had proceeded to the point where draft agreements had been prepared which will cover the construction and operation of all future water and sewage works projects provided for the Regional Municipality by the Commission. The success of this committee can lead to the establishment of similar working groups with other regional governments in the Province.

(C) LAMBTON COUNTY AREA

A public water service area was declared for the western portion of the Lambton County in 1969. Consulting Engineers were retained to prepare detailed data on the water works requirements for the area. Late in 1970, arrangements were finalized for the holding of a hearing under the Act on the proposed rates to be charged to the municipalities. Barring unforeseen difficulties, construction on the proposed area works is scheduled to commence in 1971.

(D) ACQUISITION OF PROPERTY

During the year, new procedures for the expropriation of lands required by the OWRC were worked out. Applications are now submitted to the Minis-

ter for Approval. By the end of the year, several applications had been processed. Although there is still the possibility of a considerable delay in acquiring properties under this method, the approved procedures will substantially reduce the earlier estimates for the time required to expropriate property.

(E) NANTICOKE AREA (LAKE ERIE)

Several meetings were held with municipalities in the Grand River Valley basin to review the possibility of constructing a water supply system utilizing Lake Erie as a source of supply. As a result of the meetings, the majority of municipalities advised that they were in favour of an independent study on the provision of water to the area. However, several municipalities in the vicinity of the Brantford area indicated support of the plan to use Lake Erie as the source of water for the municipalities. In view of the construction program of the Ontario Hydro Electric Power Commission in the Nanticoke area, arrangements were completed during the year to enable the OWRC to have capacity available in the intake facilities being constructed by Ontario Hydro. The independent study requested by the municipalities was under consideration by the Department of Energy and Resources Management at the end of the year.

The area also has a need for sewage works but more specific data on future land use and growth from a recent study, which has been commissioned by the Department of Municipal Affairs, will be required before any meaningful proposals can be forwarded to the municipalities.

(F) CENTRAL MORTGAGE & HOUSING CORPORATION LOANS FOR SEWAGE WORKS

The entire allotment of CMHC funds for the construction of major sewage works was utilized by the end of the year. Unless there is a significant

expansion in the funds available from this source, the advantages gained from such assistance will not be available to many new projects in the coming year.

(G) CENTRAL YORK COUNTY AREA

The implementation of a form of regional government, as of January 1, 1971, resulted in an indefinite postponement of the further development of the Commission's proposals for providing sewage and water service to the area. Discussions have been held with members of the new Regional Municipality, and further meetings will be held in 1971.

(H) BELLEVILLE/TRENTON AREA

Public water and sewage service areas under Section 46(a) of the OWRC Act were declared, encompassing 12 municipalities. An Advisory Board as well as a Technical Committee have been established to ensure a co-ordinated effort in servicing the area. Arrangements were being considered for the retention of consulting engineers to prepare reports on servicing the area.

(I) BLENHEIM AREA

A public water service area involving five municipalities was declared for the Blenheim area. An Advisory Board was established and several meetings held prior to the end of the year. It is anticipated that constructions of the required works will be commenced and completed in 1971.

PROVINCIAL PROJECTS BRANCH

The development of projects under sections 16(a) and 16(1) (d) of the OWRC Act continued at an increasing rate in 1970. The revised policy on providing financial assistance towards the capital costs of water and sewage works has increased the number of municipali-

ties requesting OWRC participation in the water and sewage works projects. There was a net increase of 56 programs accepted by the Commission during 1970, for a cumulative total, since 1964 of 318. A tabulation of statistics related to the programs follows:

	Cumulative Total Since			
	1968	1969	1970	1964
Applications Received for Sewage Works	37	31	29	250
Applications Received for Water Works	23	14	15	107
Provincial Programs Accepted by Commission	46	29	56	318
Engineering Agreements Executed for Retaining Consulting Engineers (Design Report)	55	26	45	236
Municipalities Participating in the Provincial Programs (Excluding those Municipalities Involved in Regional Studies)	32	31	4	254
Reports Received from Consulting Engineers (Draft, Preliminary, Final Design)	47	43	70	254
Tentative Rates Approved by Commission	68	52	46	202
Agreements for Final Design Executed	17	15	21	52

OWRC/MUNICIPAL
PROJECTS BRANCH

The number of water and sewage works developed under Section 39 of the OWRC Act showed a slight decrease from the previous year. However, with the availability of direct financial assistance towards the capital costs of the works, it is anticipated that this trend will be reversed in the coming year.

In 1970, 19 water projects at an estimated cost of \$5,130,000 and 14 sewage projects at an estimated cost of \$3,552,000 were accepted by the Commission. A tabulated summary of the development of these projects from 1965-1970 follows:

	1965	1966	1967	1968	1969	1970
New Projects Requested	35	29	27	36	43	33
New Projects Accepted	33	26	31	21	36	33
Preliminary Agreements Executed	31	28	23	15	22	19
Final Agreements Executed	35	30	22	37	17	13
Rating Proposals Prepared	34	32	33	20	21	21
Financial Statements Prepared	27	27	30	29	15	14
OMB Notices Prepared	26	24	25	21	18	13
Hearings	15	9	12	5	4	2

PROPERTY BRANCH

In view of the increased difficulty in acquiring properties for projects, procedures have been adopted for the acceleration of negotiations in most of the projects to ensure that the properties are available at the time of the commencement of construction. Because of the continued increase in the workload of the Branch, outside consultants have been employed to act as negotiators on behalf of the Commission. This trend is likely to continue in the coming year.

The statistics for the year, as tabulated below, indicate a substantial increase in the number of properties acquired during the year.

STATISTICS – 1970

Properties	
Properties under negotiation at end of previous year	83
New properties listed for acquisition during year	413
Options obtained or otherwise acquired..	430
Properties under negotiation at end of year	66
Options	
Options held at end of previous year	271
New options acquired during year	415
Transactions completed during year	346
Options outstanding at end of year	340
Options pending final agreement	251
Options being processed	89



Division of Research

A. J. Harris,
Director

The Division of Research provides research services to the other divisions of the OWRC and to municipalities with respect to various environmental problems. The Division is comprised of three branches — Applied Sciences, Technical Advisory Services, and Special Studies.

During 1970 the Applied Sciences Branch carried out environmental engineering-oriented investigations into twenty-two projects directly related to water management in Ontario. Such studies are generally of a relatively long-term nature and, consequently, eighteen of these projects are being carried into 1971.

Having successfully demonstrated, in a pilot plant study in 1969, the feasibility of combining chemical treatment with conventional biological process facilities to provide phosphorus removal from domestic sewage, the Division was subsequently authorized to construct and operate a full-scale installation as a demonstration and research facility. Its purpose was to provide accurate and valuable information on peripheral areas of nutrient removal, such as sludge handling and receiving water response. In 1970 the Division, in co-operation with other divisions, commenced this work, including site selection, process design, equipment selection and construction of the facility. This full-scale research system for phosphorus removal from domestic sewage was nearing completion at the end of 1970 and is due to become operational in January of 1971.

The Technical Advisory Services Branch continued its role of providing assistance in the solving of operating problems in water and wastewater treatment plants. It also has continued to provide technical advice on the capabilities of specific unit processes in proposed treatment plants and, when requested, it has recommended specific treatment processes.

As in the past, much of the work carried out during the year was conducted in co-operation with the divi-



Drinking Water Testing

sions of Industrial Wastes, Plant Operations and Sanitary Engineering. In addition to dealing with problems at municipal wastewater treatment plants, work continued on the applicability and performance of activated sludge systems for treating various wastewaters.

While a tendency to employ chemical and mechanical methods for treatment of industrial wastewaters was noted in 1969, the introduction of nutrient removal studies has increased the work load involving the use of chemicals at municipal treatment plants. It is expected that the application of phosphorus removal techniques will form a significant portion of the 1971 work load.

Assistance was given in the application and use of sodium silicate to prevent the deposition of iron in water distribution systems, and additional development work was carried out. There are now some 15 municipalities in which this treatment is being used successfully. Investigation has now turned to the removal of such silica treated iron. It is anticipated that some communities will use this process and yet supply water to industries who require an iron free supply. Normal iron removal processes do not remove silica treated iron. Several ion exchange resins provide suitable removal and other promising methods are being investigated.

The function of the Special Studies

Branch is to establish a relationship between the life sciences and engineering with a view to ascertaining the effect of engineering processes on the environment. Such programs are co-ordinated so that engineering improvements contribute to the overall improvement of the environment, rather than becoming a retrograde environmental step.

During 1970, work continued on the investigation of the use of gamma irradiation as a source of energy in the treatment of wastewaters. The irradiation sources of energy, provided by Atomic Energy of Canada, Limited, as part of a co-operative program involving Division of Research staff and facilities, have resulted in a unique research capability which has brought international recognition of the OWRC group, as the search for advanced waste treatment methods expands.

The effects of gamma irradiation on domestic and industrial wastewaters and on biological organisms, both bacteria and virus, have been studied.

The following brief descriptions of major work carried out during 1970 by the three branches of the Division illustrate the nature and scope of the investigations:

APPLIED SCIENCES BRANCH

Chemical Treatment of Domestic Sewage for Phosphorus Removal

The Applied Sciences Branch continued its investigation of chemical treatment of domestic sewage for phosphorus removal. In addition to carrying out applied research on phosphorus removal methods and studying the effects of such treatment on receiving water eutrophication, the Branch also gave advice and guidance to many interested organizations and individuals concerning phosphorus removal. Papers on the removal of phosphorus by the use of lime were presented by a member of staff at conferences in Montreal and Winnipeg.

Laboratory Investigations.

Laboratory investigations into the chemical removal of phosphorus from domestic sewage during 1970 involved the evaluation of the effects of various nutrient removal processes on the eutrophication properties of sewage effluents, the evaluation of the effectiveness of waste materials from industrial processing in precipitating phosphorus from sewage, and a study of the nutrient release relationships of various chemical sludges resulting from the chemical precipitation of phosphorus from sewage.

Pilot Plant Investigations.

Early in the year, a pilot chemical sewage treatment plant was constructed for research work. This pilot plant was first evaluated at the laboratory and found to produce high phosphorus, BOD (Biochemical Oxygen Demand) and SS (Suspended Solids) removals when treating domestic sewage. In order to obtain information to assist in the design of full-scale nutrient removal facilities for the Town of Markham WPCP, the pilot plant was installed at that site. Studies using hydrated lime and waste carbide-lime slurry determined both chemicals to be suitable for effecting phosphorus removal from the Markham sewage.

In co-operation with the Division of Sanitary Engineering and the Town of Bala, the pilot plant was installed at the Bala STP site during May of 1970, to chemically treat, with lime, the total effluent from the existing percolating filters. The purpose of the installation was to gain further information on the process, to provide an alternative treatment process for Bala and to determine treatment effects on the receiving waters. In conjunction with this study, an application of alum was made to CNR Bay, the receiving water for the Bala sewage treatment plant effluent. This application effected excellent precipitation of phosphorus, algae and

colour from the bay water and its effect was visually apparent throughout the remainder of the summer and fall. The pilot plant will be operated throughout the winter and the coming 1971 summer season.

Full-Scale Field Evaluations.

Full-scale field evaluations of aluminum sulphate and of ferrous chloride were carried out at the Kleinburg extended aeration sewage treatment plant to determine the feasibility of removing phosphorus through chemical addition to such a plant. These studies showed that either of these chemicals may be successfully used in effecting phosphorus removal within an extended aeration, activated sludge plant.

Following the work done during 1969 at Richmond Hill and Sault Ste. Marie on the lime treatment process for phosphorus removal, construction of the necessary facilities was undertaken at the Newmarket/East Gwillimbury WPCP to further study this process as a full-scale research program. Construction of these facilities is expected to be completed early in 1971. Prior to the initiation of the construction of these facilities a pre-process evaluation of the existing plant process was carried out.

Farm Animal Waste Management

The Applied Sciences Branch has continued its involvement in a number of activities concerning the problem of farm animal waste management. These include:

- presentation of papers in Ottawa, Centralia, and London;
- representation on the University of Guelph Animal Waste Utilization Committee, the Fertilizer Use and Pollution Committee, and a sub-group of the Working Group on Great Lakes Pollution;
- giving advice and guidance to the agricultural industry, other governmental agencies and individuals;
- keeping abreast of developments

throughout the world on the farm animal waste management problem.

Cladophora

A chemical application was made to a growth bed area of *Cladophora* in the Oakville area of Lake Ontario in an attempt to tie up the phosphorus and make it unavailable for algal growth. No apparent success was achieved.

Enhanced Biological Removal of Phosphorus

Work continued in 1970 to determine the capability of the activated sludge process for removing phosphorus. During the initial phase of the study, a survey of the literature was undertaken to review reports on enhanced biological removal of phosphorus and a nutrient monitoring program was carried out at 17 WPCPs to determine phosphorus removal effectiveness through various types of activated sludge plants operating under normal conditions. Reports by agencies elsewhere, and preliminary investigation by the Division of Research, indicate that some WPCPs yield unusually high phosphorus removal levels through the sewage treatment plant process, without the addition of chemicals. In the present phase of the study, bench scale experiments are being conducted to determine modifications which may be made to the conventional activated sludge process to enhance the biological removal of phosphorus.

Removal of Anionic Detergents by Municipal Treatment Plants

A study, begun in 1969, to determine the effect of the conversion from "hard" alkyl benzene sulphonate (ABS) surfactant in detergents to the more readily biodegradable "soft" linear alkylate sulphonate (LAS) compounds on the quality of effluent from sewage treatment plants was completed in 1970. The removal of surfactant material has increased from between 26 per-

cent and 86 percent before LAS, to between 60 percent and 94 percent after its introduction. Efficiency of removal of LAS is related to the mixed liquor suspended solids level and to the detention time in the aeration tank. When the sewage treatment facilities are overloaded or poorly operated, lower LAS removals result. A report presenting the results of these studies is being prepared.

Frazil Ice

Work was continued in compiling data on the occurrence and prevention of the formation of frazil ice in surface water intakes. The data being obtained will be used to aid authorities in Ontario concerning the action to be taken to alleviate these problems. The data will also be useful in the review of the design of new intakes.

Domestic Sewage Sludge Incineration

Preliminary investigation has been started on the possible application of the incineration process to the treatment and disposal of domestic sewage sludge. Because of the importance being placed upon the use of lime in the chemical treatment of domestic sewage for phosphorus removal, particular emphasis will be placed on lime recovery and reuse. Also, with the increased interest in refuse incineration, utilization of such systems to incinerate sewage sludge along with the refuse will be studied.

Gamma Irradiation of Sewage and Sewage Sludges

A report was prepared on the use of gamma irradiation as a sewage sludge volume-reducing agent, with continuous monitoring on the supernatant quality. Dose rates ranged from 60 to 35,500 rads/min with total doses of irradiation from 10^1 to 10^7 rads. A dose of approximately 10^6 rads of high-rate irradiation produced some beneficial reduction of raw sewage settled solids

volume. Sewage sludges (waste activated, mixed liquor, and digested) showed optimum response between 5×10^4 and 10^5 rads of higher rate irradiation, above which sludge flotation and poor quality supernatants were obtained.

Nutrient Removal From Lagoon

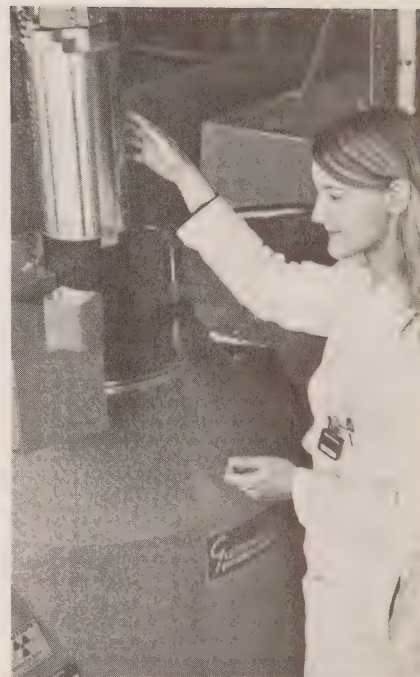
A 10,000 litre (2,200 gallon) waste stabilization pond was set up in the laboratory to study the effects of pre-treatment and post-treatment on effluent quality. Raw sewage, precipitated with 300 ppm lime, was the influent for one-half of the lagoon; primary effluent was used in the other. The high pH influent had no noticeable effect on the lagoon as a polishing unit. Post-treatment of the lagoon required less chemical to effect the same effluent quality as the pretreated lagoon but it produced undesirable alterations in pH. It was evident that a more complicated post-treatment system would be necessary, incorporating pH neutralization.

Use of Tracer Dyes

A report was prepared as a result of numerous requests for information from the public and staff regarding the use of fluorescent organic dyes for tracing pollution and studying movements of water in a wide range of applications. The report gives a brief summary of the chemical and physical data, as well as other pertinent information on some of the commercially available fluorescent dyes.

Treatment of Receiving Water

A public demonstration was conducted at Newmarket, under the auspices of the Holland Valley Conservation Authority, involving the use of alum as a possible method of cleaning up and restoring the aesthetic quality of a lake designated for recreational purposes. A report was prepared by the research staff who witnessed this demonstration. The economics of such treatment are being assessed.



Gamma Irradiation Experiments

Evaluation of Chemical Oil Dispersants

Several letters of inquiry were sent out to various firms in Canada, United States and abroad requesting information and samples of chemicals and materials that are commercially available for cleaning up and controlling oil spills. To date, some forty samples have been received and are being tested for effectiveness and toxicity.

Well Contamination Investigation

Four cases were reported of farm wells contaminated by seepages of fuel oil and gasoline. Staff investigated two of these to determine methods of alleviating the problem. In the other two cases, staff advised on practical methods that could be utilized to eliminate the obnoxious tastes and odours.

STP Effluent Disinfection

A research study was initiated to investigate some of the factors which affect the efficiency of chlorine disinfection of sewage plant effluents. The Branch was requested to investigate some of the recurring problems related to high coliform counts at some of the plants, in spite of good clarity and adequate chlorine residuals in chlorinated effluents. The study has involved monitoring of chlorine consumption, chemical and physical characteristics of sewage, and plant flows. Tracer studies were also carried out to determine flow patterns in the chlorine contact chambers of these plants.

Reverse Osmosis Studies

A small laboratory model of a reverse osmosis unit has been obtained to determine the feasibility and application of this process for purification of waters and wastewaters.

Treatment of Uranium Mining Wastes

Further studies were continued in the treatment of waste effluents from uranium milling plants at Elliot Lake. This work has involved the evaluation of chemical treatment of effluents from the tailings ponds and its effects on the chemical quality.

TECHNICAL ADVISORY SERVICES BRANCH

Wastewater Section

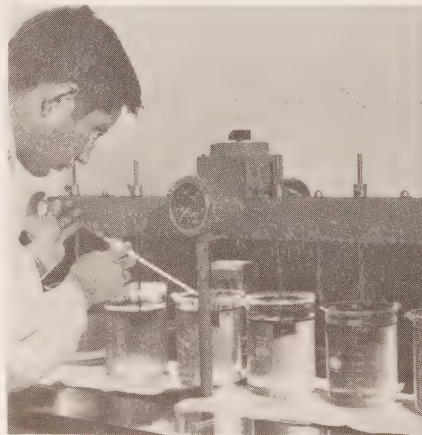
An on-site pilot scale biological sewage treatment study was conducted at Sudbury. This investigation, requested by the Division of Sanitary Engineering, confirmed the proposed sewage treatment plant design parameters suggested by the consultant. Results indicated that the sewage strength was typical of that from most municipal sources, with copper and nickel concentrations being less than 0.5 mg/litre. It was concluded that adequate biological treatment could be achieved with a

nominal four-hour retention in the aeration section. The study further indicated, however, that the proposed treatment plant would have to be capable of satisfying extremely high oxygen utilization rates.

At the request of the Division of Sanitary Engineering, a detailed assessment was made of the first municipal application in the Province of an oxidation ditch treatment system at Port Elgin. Although a very high quality effluent was attained, the oxygen supply was marginal. Field investigations indicated that the oxygen transfer capabilities of the rotors were considerably less than expected. Additional work is being conducted that should yield results that will support or deny present ditch criteria.

Many proposals have been submitted to the Commission involving the use of short-term preaeration lagoons as a means of expanding existing treatment facilities. As a result, the performance and operating characteristics of a few existing installations were evaluated. The results of this study yielded design parameters for short-term aerated lagoons, including both facultative and mixed aerated lagoon systems.

Oil Dispersant Tests



Work involving the use of tube settlers to overcome hydraulic overload of final clarifiers continued. Full-scale installation of these units at the West Don WPCP allowed the treatment system to handle approximately twice the design hydraulic load. Field studies in connection with a pilot scale unit at Durham indicated that adequate clarification could be obtained at flow rates of approximately 1.5 GPM/sq.ft.

In a co-operative effort with the Division of Plant Operations, a conical bowl continuous-feed centrifuge was operated for several months at Brampton-Chinguacousy WPCP. Three types of sludges and a variety of sludge conditioning chemicals were investigated. It was found that a two polymer system, one cationic and one anionic, with lime addition, provided the best results. Using raw or digested feed sludge at 4 percent total solids concentration, the centrifuge was able to concentrate this to 20 percent total solids on a continuous basis at approximately 1,500 gal/hr. Operating assistance was provided when the centrifuge was later installed and operated continuously at the Simcoe WPCP.

Over the past several years, there has been a noted increase in the demand for WPCP effluent of a higher quality than that provided by secondary treatment. In response to this need for higher quality effluent, a study of effluent polishing techniques was undertaken. This investigation, which is continuing at the present time, deals with pressure filtration, upflow and downflow filtration, and single, dual and multi-media filtration. To initiate this study, a 30 in. diameter pilot scale immediate filter unit was installed at the Brampton-Chinguacousy WPCP. This relatively new type of filter is an upflow unit using coarse media and high flow rates. An unique upper grid prevents the bed from fluidizing at these high flow rates.

At the request, primarily, of the

Division of Industrial Wastes, several bench-scale studies were conducted to determine biodegradability and/or treatability of specific wastewaters. This type of work assists municipalities in assessing the effects of particular industrial wastes proposed for discharge to sewerage systems.

Further use was made of bench-scale activated sludge plants to study the effects of the discharge of water treatment plant sludges upon the activated sludge system. Such sludges have little associated organic load and the effect upon treatment systems is, primarily, a hydraulic one.

Work continued with respect to the wastewater discharges of Uniroyal Ltd. to the Elmira WPCP. Through in-plant changes and isolation of particular waste streams, the Company has managed to maintain a reduced but continuous COD (Chemical Oxygen Demand) load level being directed to the WPCP. In addition, cyanide wastes have been isolated for separate disposal. Pretreatment of the Company's UBOB wastes was effected by alkaline chlorination. This has resulted in a significant reduction in WPCP effluent colour and has also reduced the COD load being placed upon the treatment plant.

The increased activity of the Wastewater Section was most apparent in the laboratory where there was a 123 percent increase in samples received and a 41 percent increase in analyses performed. The TOD (Total Oxygen Demand) analyzer, purchased last year, has proven to be a most valuable piece of equipment, accounting for 3,572 analyses or 24 percent of the total. Routine analyses continue to be sent to the Division of Laboratories.

A model anaerobic digester, started up at the beginning of the year, was closed down in April. It was concluded that there are no benefits in the anaerobic digestion treatment of lime sludges and that these sludges are not amenable to anaerobic digestion. A similar project

is being carried out using an aerobic digester.

Water Purification Section

Treatability studies for communities, such as Longlac, Beardmore, Newburgh, Sundridge and Casselman, were performed in order to select the most applicable water treatment processes for their new water plants. Other communities, such as Amherstburg, Port Hope, Beaverton and Goderich, sought assistance in increasing the output of existing plants without undertaking major additions or alterations. The additional capacity is generally obtained by the use of coagulant aids such as activated silica, flash mixing, mechanical flocculation, high rate sedimentation (tube settlers) and high rate filtration.

Several interesting new developments in the field of water treatment were investigated during the year. A high rate iron-removal filter media was examined during tests at one of the Township of Markham wells. A flotation method for algae removal with alum floc was tested during a taste and odour removal study at Apsey Lake for the Town of Espanola. A new type of diatomaceous earth media, which had been treated to provide colour removal, was also tested briefly and gave promising results. Further tests on highly coloured waters will be run in 1971. If satisfactory, this media could provide effective colour removal, especially in the case of northern waters of low turbidity and high colour.

Algae removal by solids contact clarifiers has always been unpredictable. A study to determine the factors which control the degree of removal was started during the year. It would appear that the underlying factor is the contact time with chlorine or potassium permanganate prior to coagulation. Tests indicate that the contact time is much more significant than chlorine residual. A contact time of about 10 minutes is required in order to incapacitate the

algae to the point where the minute forces of coagulation can hold it and flocculate it with a view to removing the algae with the turbidity.

SPECIAL STUDIES BRANCH

Eutrophication of Soft-Water Lakes

Following the collection of biological and physical-chemical control data on four small lakes in the Elliot Lake area in 1969, three of the lakes were selected for fertilization with various simulated domestic waste treatment effluents (one being left for control purposes). These different types of treatment represent conventional and promising experimental approaches to nutrient removal. The reaction of the lakes to these simulated effluents will determine the best practical treatment of wastewater for ultimate disposal to soft-water lakes, many of which have high levels of natural phosphorus.

The simulated effluents were added to the lakes in gradual doses from June to September. Monitoring of primary production, algae, zooplankton, bottom fauna, and physical and chemical parameters was carried out from April until late November. As a result of the inclusion of these diverse parameters, data on the effects of the treatment processes on the complete limnology of unpolluted soft-water lakes will be available.

Bottom Fauna

The existing biological reference material, identified by recognized experts, was catalogued and organized into a small reference collection. At the present time, most of the specimens are molluscs with a few mosquitoes and other insects. However, as the collection grows it will be very valuable for the detailed taxonomic work involved in future water quality assessment programs.

In order to add to the reference collection, work has continued on the

in-depth biological classification of organisms collected during routine surveys. Some aquatic larvae, such as the chironomidae, require the adult stage for species identification. This necessitates the collection of larvae and their subsequent rearing to the winged adult. Extensive field collections of these larvae were, therefore, made on Lake Simcoe and the Muskoka Lakes.

In Vitro Nutrient Phytoplankton Bioassay Experiments

Samples of water obtained from several hard and soft-water lakes were enriched with additions of nitrogen, phosphorus and/or continuous feeding of organic carbon. Biomass responses estimated from weekly suspended solids and chlorophyll determinations were quite variable. Organic carbon fertilization, without the addition of nitrogen and phosphorus, was found to repress algal development particularly at higher concentrations. Lower levels of organic enrichment with the addition of nitrogen and phosphorus were found to be stimulatory to algal development in certain cases.

In Vivo Nutrient Phytoplankton Bioassay Experiments

From research studies carried out in the Kewartha Lakes and the Bay of Quinte during 1967 and 1968, concentration values were derived for total phosphorus and total nitrogen in the trophogenic zone of surface waters, such as will not result in nuisance productions of phytoplankton. Field trials to critically assess these values were carried out by enclosing natural lake water in either plastic columns or bags at Lake-on-the-Mountain, a moderately productive hardwater lake.

Phytoplankton responses in these enclosures to fertilization with nitrogen, phosphorus and various other materials such as NTA (Nitrilo-triacetic-acid), citrate, etc., were characterized by parameters which included chlorophyll

determinations, radioactive productivity measurements, and enumeration of the biomass. Limnological changes in the open lake were also examined at regular intervals.

Virus Isolation

A comparison was made of the relative efficiencies of three methods recommended for the isolation of low numbers of viruses from water samples. The samples were artificially seeded with E coli B bacteriophage, a bacterial virus which was used as the test organism.

The simplest of the methods — the concentration of the water samples within dialysis sacs immersed in polyethylene glycol — proved unsuccessful for virus at levels less than 50 particles per litre. A two-phase separation method, employing polyethylene glycol and sodium dextran sulphate, proved little more sensitive and involved a fairly lengthy separation procedure. The most promising method proved to be the adsorption of the virus on to 0.45 μ Millipore filters by the standard filtration procedure, followed by elution with beef extract. This procedure is simple and rapid, and the amount of water tested is limited only by the capacity of the filter, and can be extended by the use of fibreglass pre-filters for turbid waters. Extensive testing of several kinds of surface waters, tap water and wastewater was completed, and a report was prepared (Research Publication No. 37).

Gamma Irradiation

Throughout the year, studies were continued on the possible applications of the gamma irradiation process to the treatment of water and wastewater. These included the following:

(a) As Applied to Taste and Odour:

Preliminary experimentation early in the year indicated that gamma irradiation was effective in the reduction

of taste and odour caused by Actinomyces. The reduction in threshold odour number of water, contaminated by the purified extract of the taste and odour compound from a species of Actinomyces, was found to be equivalent to that obtained with 50 ppm Nuchar (activated carbon) for a contact period of 30 minutes. Later work confirmed these results, indicating that such a reduction was effected by doses of gamma irradiation as low as 8.4×10^3 rads administered at a dose rate of approximately 3.5×10^4 rads per minute. Preliminary results of peak analysis, after gas chromatography carried out on preparations of the taste and odour component, indicated a modification in the specific peak after gamma irradiation treatment.

(b) As a Raw Wastewater Disinfectant:

In the area of wastewater treatment, disinfection of activated sludge was achieved at doses above 10^5 rads, although viable bacteria remained even at doses of 10^6 rads.

The disinfection of sewage by means of gamma irradiation was also investigated. For raw sewage, good disinfection resulted upon exposure to 2.5×10^5 rads in a batch-type system. Total coliforms were reduced to less than 200 per 100 ml and the total count decreased two to three orders of magnitude. The treatment did not inactivate all the test bacterial virus.

Division of Research personnel advised representatives of Atomic Energy of Canada Limited, Commercial Products Division, on the installation in Germany of a batch-type irradiation system for the treatment of hospital wastes.

(c) As a Treated Wastewater Disinfectant:

Gamma irradiation treatment was applied to the secondary effluents from extended aeration sewage treatment plants. Results indicate that a dose of 1.7×10^5 rads at a dose rate of about

3.4×10^4 rads per minute reduced total coliforms to levels undetectable in 1 ml samples, and reduced the total bacterial count to 10^3 to 10^4 per ml; enterococci and spore-forming bacteria were more resistant to treatment than coliforms and bacterial viruses were not completely inactivated. There was no apparent change in the BOD, TOC, total phosphate or detergent content of the effluents after gamma treatment.

(d) When Used in Combination with Chlorine:

Experiments were continued on microbial inactivation in water by gamma irradiation to elucidate former indications of a potentiating effect of gamma irradiation on chlorination. It was found that previous exposure of the cells of *E. coli* to gamma irradiation doses in excess of approximately 10^4 rads rendered them more sensitive to the action of low doses of chlorine.

Further experiments with aqueous suspensions of *E. coli* showed that the degree inactivation of the cells was dependent on the total irradiation dose, and was not affected by the dose rate at which the particular total dose was applied.

The findings of the gamma irradiation studies were incorporated into two reports which were forwarded during the year to Atomic Energy of Canada Limited, Commercial Products Division.

(e) Effect on Refractory Industrial Wastes:

A project was initiated in May to study the effects of gamma irradiation on refractory industrial wastes. Since a biological treatability study was currently underway, using waste from the aerated lagoon at Chemical Developments of Canada Limited, it was decided to begin with this waste.

Chemical characterization of the waste has been carried out. Four types of sample were analyzed to determine their characteristics: raw waste, irradiated raw waste, post-biologically

treated raw waste, and post-biologically treated irradiated waste. A synthetic waste was made up consisting of compounds (product and raw material) present in the raw waste which showed similar characteristics to that of the waste from the aerated lagoon. Samples of single compound solutions were analyzed for their biodegradability and other chemical parameters in an attempt to determine the refractory component of the waste.

Certain compounds which appear to pass through biological treatment of the raw waste (activated sludge laboratory units) had either disappeared or were reduced following biological treatment of irradiated raw waste. In order to make a direct comparison of irradiated and non-irradiated waste treatments, parallel biological units treating raw waste and irradiated raw waste were run. (The makeup and strength of the raw waste varied considerably from that of the initial biological treatability study). Results obtained to date appear to indicate that the irradiated raw waste is slightly less amenable to biological treatment. Further experiments are to continue with varying irradiation dosages and aeration levels.

Analog Simulation of Stream Dissolved Oxygen Levels

An analog of the effect of wastes on receiving streams was further developed. The model was run through on the digital computer using a Quiktran program. A number of assumptions were made, involving aquatic plant distribution, light intensity (and accompanying photosynthetic oxygen production) variation, and other factors affecting dissolved oxygen levels in streams. Time of day and distance of flow variations in dissolved oxygen in a hypothetical receiving stream were calculated. The changeover from the Quiktran to the Call/360 computing system necessitated a number of changes to the simulation. The revised model has not yet

been run on the new system. Prediction of permissible loadings to receiving streams should be possible, given the pertaining biological data.

Nutrient Removal — Effect on Receiving Streams

Field studies continued on the Rouge River, above and below the tributary containing the Markham Village WPCP effluent. Dissolved oxygen and temperature measurements, and chemical analyses were made on a weekly basis throughout the summer and fall. Growth of aquatic plant life appeared to be lower than in the previous year. A definite date for the initiation of nitrogen and phosphorus removal at the Markham Village WPCP has not yet been established. Further monitoring of the dissolved oxygen and other chemical parameters is planned for 1971.

'Unox' — Union Carbide's Pure Oxygen Waste Treatment Process

Division of Research personnel explored the possibility of introducing a 'Unox' process into an expanding Ontario sewage treatment plant. A visit was paid to the Batavia, New York, sewage treatment plant to inspect an operating 'Unox' installation there and a visit was also made to the Union Carbide Laboratories at Buffalo, New York, for further discussion of the process.

Effect of Detergents on Water Supplies

Data and information concerning the effects of synthetic detergents on water supplies were collected. A paper is being prepared by Division of Research personnel as an updated review of this subject for the American Water Works Association.



Division of Sanitary Engineering

J. R. Barr,
Director
G. R. Trewin,
Assistant Director

The program of the Division of Sanitary Engineering deals with the management of water under three categories: water quality, water supply, and pollution control. The program responsibilities are handled by five activity-related branches and two staff positions. The branch functions are: (a) the evaluation of plans of proposed water supply and wastewater treatment installations; (b) a field activity program including pollution surveys and pollution complaint review, subdivision review, and the promotion, inspection and supervision of water and wastewater treatment plants; (c) a water quality guidance program including basin studies, wastewater treatment evaluations as related to the effect of inputs on receiving waters, and the surveillance and monitoring of water quality; (d) the supervision of plumbing and the control of pollution from watercraft; and (e) the planning of regional water supply and wastewater treatment facilities.

The two staff functions provide guidance to the Division's water supply and wastewater treatment programs.

Public Hearings

An important function of the Commission is the holding of public hearings with respect to sewage works. When a municipality intends to install sewage works in another municipality, the Commission, as required under the OWRC Act, *must* hold a public hearing. In addition, the Commission may hold public hearings before approving sewage treatment works to be located within the municipality to be served or which are to be privately-owned and operated. The purpose of the hearings is to ensure that the intended works will not adversely affect adjacent properties and to inform the local residents of the extent of the proposed works. The public is given an opportunity to have questions answered regarding the works.

During 1970, 34 public hearings were held in municipalities regarding

proposed sewage works. Nineteen of the hearings involved Provincial projects under development by the OWRC. This brings the total number of hearings held since 1959 to 266.

Training Programs

Special emphasis is placed by the Division upon the importance of training. The two-day practical workshops, held in various areas of the Province, continue to be very well received. A Coagulation-Flocculation-Sedimentation-Filtration Workshop was held at the Lakeview Water Filtration Plant. Three Chlorination Workshops were held at the Brantford, Windsor-Tecumseh and Thunder Bay Water Treatment Plants. A total of 106 men attended the Chlorination Workshops.

The regular Water Treatment Plant Operator Courses also continue to be well received, with 113 men registering for the Seventh Basic and 109 registering for the Seventh Intermediate Water Works Operators Course. In addition to the regular course, a special one-week course was held for Distribution System and Deep Well Operators.

The Intermediate and Senior Sewage Works Operator Courses were held, with the attendances being 130 and 127, respectively. The total number of successful candidates completing courses since 1960 is 643. Each year the number of requests from persons wishing to attend the courses increases.

In addition to continuing the above-mentioned previously developed courses and seminars, two new AWWA/OWRC-sponsored seminars were held during the year. These seminars dealt with the topics of "Safety" and "Preventative Maintenance" and were attended by 63 and 95 water works superintendents and foremen, respectively.

During 1970, staff began to assess OWRC training needs with a view to considering the desirability of the licensing of water and wastewater personnel. It is evident that the water and sewage

works operator courses, summarized above, exposed the operators to a great deal of information. The degree to which these courses have met the training needs of the water and sewage works industry, however, has not been fully assessed, and it is planned to provide courses where "hands-on" skills may be attained. To this end, information was gathered on training and licensing programs underway in the U.S., the U.K. and the rest of Canada and a consultant was retained to prepare a report on training and licensing of water and wastewater personnel.

DESIGN APPROVALS BRANCH

The Branch appraises engineering reports, plans and specifications submitted for the approval of water works and sewage works in accordance with Sections 30 and 31 of The Ontario Water Resources Commission Act.

Applications and Approvals

The Branch processed 1,939 applications and engineering reports during 1970. This resulted in a total of 1,848 certificates of approval being issued, representing a total estimated value of \$218.3 million. In 1969, 2,209 certificates were issued at a total estimated expenditure of \$207.6 million.

Certificates issued for water works applications totalled 821 and involved an estimated expenditure of \$64.6 million, compared with 943 certificates and an expenditure of \$54.7 million in 1969.

In the sewage works field, 1027 certificates were issued during the year at an estimated cost of \$153.7 million, compared with 1,266 certificates in 1969 at an estimated cost of \$152.9 million.

Table 1, below, provides a breakdown of the total estimated value of works with respect to type of approval issued in 1970. Comparative 1969 figures are also provided.

TABLE 1

SUMMARY OF WATER AND SEWAGE WORKS APPROVALS

Estimated Costs

Water Works	1969	1970
Extensions to existing systems	\$ 45,130,885	\$ 53,646,578.19
Supply and purification	8,259,350	10,202,738.09
New systems	1,314,772	776,826.31
Total for water works	\$ 54,705,007	\$ 64,626,142.59
Sewage Works		
Extensions to existing systems	\$126,297,942	\$131,718,769.10
Treatment and disposal	25,326,906	14,849,077.80
New systems	1,274,554	7,120,589.29
Total for sewage works	\$152,899,402	\$153,688,436.19

Of the total number of certificates issued in 1970, 33 were for OWRC/Municipal water works projects, and 27 were for OWRC/Municipal sewage works projects. Estimated costs of the projects were \$1.5 million for water works and \$2.2 million for sewage works. Also included in the total number of certificates issued were 21 for Provincial water works projects and 30 for Provincial sewage works projects. Estimated costs for these projects were \$14.5 million for water and \$32.5 million for sewage. Table 2, below, provides a summary of the value of works with respect to OWRC/Municipal and Provincial works.

Sewage Treatment Plant Approvals

Approvals were issued for the construction of 13 new municipal sewage treatment plants and for the extension of 15 existing plants. Table 3 shows the municipalities for which these approvals were issued.

The graphs (Figures 1 and 2) show the value of water and sewage works systems approved from 1957 to the present.

TABLE 2

OWRC/MUNICIPAL AND PROVINCIAL PROJECTS

	1969	1970
OWRC/Municipal		
Water Works	\$ 2,094,832	\$ 1,546,847
Sewage Works	4,296,991	2,206,573
	\$ 6,391,823	\$ 3,753,420
Provincial		
Water Works	\$ 7,593,046	\$14,543,290
Sewage Works	15,312,357	32,474,161
	\$22,905,403	\$47,017,451

Miscellaneous

The Branch repeated the annual fluoridation survey of all municipalities using controlled fluoridation.

The responsibility for approving individual applications from municipalities for loans from the Central Mortgage and Housing Corporation with respect to water and sewage works was assumed by the Branch in 1970.

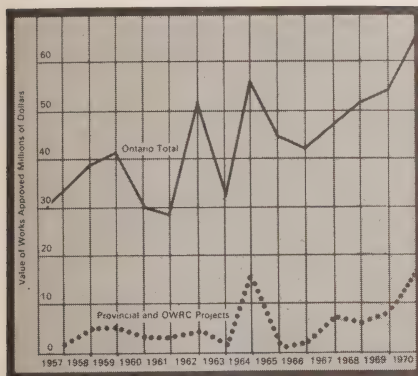
TABLE 3

MUNICIPAL WATER POLLUTION CONTROL PLANT APPROVALS ISSUED DURING 1970

Municipality	New Plant or Extension	Estimated Cost
Arthur (Prov.)	Extension	\$ 61,318
Barrie	Extension	146,261
Belleville (Prov.)	Extension	2,450,000
Bradford (Prov.)	Extension	856,800
Cannington (Prov.)	New Plant	165,855
Carleton Place (Prov.)	New Plant	625,000
Cayuga (Prov.)	New Plant	269,350
Deseronto (Prov.)	New Plant	589,540
Eganville (Prov.)	New Plant	130,000
Fergus (OWRC/Municipal)	Extension	506,900
Goulbourn (Munster Hamlet)	New Plant	55,000
Listowel (OWRC/Municipal)	Extension	140,000
Lively	Extension	61,900
Madoc (Prov.)	New Plant	125,000
Marathon	Extension	4,500
Markham	Extension	77,000
Neelon & Garson (OWRC/Municipal)	Extension	240,111
Newmarket & East Gwillimbury	Extension	70,000
Pickering Twp.	Extension	470,000
Port Perry (Prov.)	New Plant	230,094
Prescott (Prov.)	New Plant	637,250
Richmond (Prov.)	New Plant	65,000
Richmond Hill (OWRC/Municipal)	Extension	279,000
Smiths Falls	Extension	450,000
Stayner (Prov.)	New Plant	118,651
Sudbury	New Plant	4,055,000
Tillsonburg (Prov.)	Extension	679,400
Uxbridge	Extension	13,100

In connection with the Pollution Abatement Incentive Act passed by the Province in mid-1970, which provides for Ontario Retail Sales Tax rebates on equipment used for pollution control, the Design Approvals Branch certifies the validity of claims made in the municipal pollution control field.

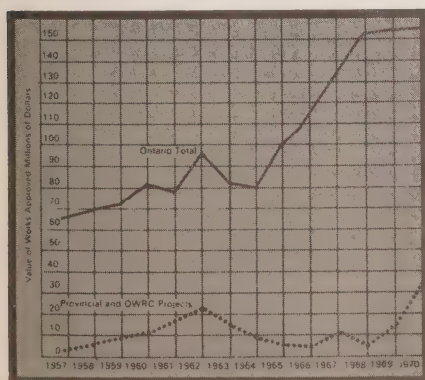
Fig. 1
Summary of Water Works Approvals



DISTRICT ENGINEERS BRANCH

Field work of the Branch, which is responsible for both service and regulatory programs, is carried out under the supervision of six district engineers, each of whom covers designated areas in Ontario. During the year, inspections and evaluations were made in every part of the Province.

Fig. 2
Summary of Sewage Works Approvals



The Branch maintains an intimate contact with municipalities, water supply and pollution abatement organizations and the general public. With a view to providing a maximum level of service to the people of the Province, professional and/or technical staff members of the Branch are now located in Toronto, London, Sault Ste. Marie, Kingston, Thunder Bay, Galt and Peterborough.

Basic Programs

Routine work during the year included the assessment of water works and sewage treatment plants; the performance of water pollution surveys; the inspection of sanitary landfills, cattle feed lots, piggeries and poultry-raising plants relative to the possibility of their contributing to water pollution; and the evaluation of proposed plans of subdivisions and official plans of development, with a view to providing recommendations regarding water supply and sewage disposal.

District staff performed 983 evaluations of water works during the year. The number of recorded water works inspection points in 1970 was 1,069. In addition, there were 598 evaluations of wastewater treatment plants performed, with the number of inspection points totalling 566.

As part of the water pollution control program, field staff performed 74 municipal water pollution surveys. These surveys are designed to locate pollution sources and promote the collection and treatment of the offending wastewater discharges. The survey reports are used to substantiate the need for certain works to both municipal officials and the Ontario Municipal Board.

To ensure the provision of proper water supply and sewage disposal, and particularly to keep pace with municipal development, the staff of the Branch provides to the Department of Municipal Affairs an assessment of each subdivision and official plan proposed for

development in the Province. There were 910 subdivision and 132 official plans processed in 1970.

The staff of the District Engineers Branch continued to have an increasing amount of direct contact with water works and sewage works personnel and municipal officials throughout the Province. During 1970, staff attended 993 meetings and hearings. This is an important aspect of the District Engineers Branch activities as it brings about a direct contact between local officials and the Commission in promoting and initiating projects for the installation of necessary water and sewage facilities.

Special investigations requested by municipalities, the public and senior staff of the Commission also constitute a sizeable portion of the work of the District Engineers Branch. A total of 1,181 of these requests were received and acted upon. The following are significant examples of the type of investigation carried out:

- Don River — Oil Spill
- City of Belleville —
Hydrofluosilic Acid Spill
- Town of Port Hope —
R.R. Derailment — Herbicide Spill
- Town of White River —
Oil Pollution
- Regional Municipality of
Ottawa-Carleton — Closing of
Bathing Beaches.

Recreational Water Pollution Control Program

The recreational water pollution control program is a new program within the Commission. Early in 1970, interest and concern at a senior government level resulted in the Deputy Ministers' Committee on Pollution Control establishing a task force to report on pollution control in cottage areas. The report prepared by the task force recommended a two part program designed (a) to ensure that new cottage development was adequately planned to

prevent additional problems; and (b) to detect and correct existing pollution problems in critical recreational areas. The main recommendations of the report were adopted by the Government. The Branch, in co-operation with the Division of Laboratories, was assigned the task of evaluating the water quality of selected lakes, working in conjunction with the onshore detection and correction teams of the Department of Health.

The water quality survey group performed intensive surveys of Stony, Clear, Lovesick, Jack, Steenburg, Bass, Riley, Sparrow and Kushog lakes and partial surveys of Balsam, Cameron, Six Mile, Otter, Lower Beverley and the Rideau lakes.

In addition to the regular lake survey program, a self-help program is being developed with a number of cottage associations. This will enable the associations to obtain some water quality data in lakes not slated for full scale study in 1971.

In 1971 it is proposed to expand the water quality survey program to include nutrient budget studies to be undertaken by the Biology Branch of the Division of Laboratories. This step is most important if nuisance levels of algae blooms are to be avoided in recreational lakes.

Educational Television

A twenty-seven minute educational television film "The Water Resources Technologist" was prepared in co-operation with the Ontario Department of Education.

Litigations

The time spent in collecting samples for prosecution, case preparation, and court appearances increased during the year. One case of interest was the prosecution of a municipality in Ontario for unnecessary discharge of raw sewage during sewer repairs. The court registered a conviction and levied

the maximum \$1,000 fine.

Solid Waste Disposal

The Branch continued to be active in assessing existing and proposed sites for solid waste disposal. In co-operation with the Waste Management Branch of the Department of Energy and Resources Management, it supported the move to protect the Stouffville municipal water supply by recommending against the discharge of liquid industrial wastes to a disposal lagoon located directly above the aquifer which is the source of supply for the municipal system.

Drinking Water Safety

The Branch ensures that proper disinfection of drinking water is carried out at 1,069 water works in the Province in order to guard against the incidence of water-borne diseases caused from the ingestion of pathogenic organisms. Similarly, the Branch is required to ensure the safety of fluoridation programs whenever fluoride is added to a potable water supply for the prevention of dental caries.

Evaluations of Proposed Works

The Branch provides comments on the adequacy of proposed OWRC/Municipal or Provincial-financed water works and sewage works systems.

PLUMBING AND BOATING BRANCH

In the Province of Ontario the installation, maintenance and repair of plumbing, with a few minor exceptions, is controlled by the Provincial Plumbing Regulation. The Branch is responsible for ensuring that this Regulation is kept up-to-date and also for providing technical liaison with municipal inspectors. The Branch is assisted in its function of maintaining a modern code by the Plumbing Advisory Committee made up of representatives from industry, municipal regulatory authorities and engineer-

ing and water pollution control associations.

A survey of the Province indicated that a number of municipalities are not providing a plumbing inspection service as directed in the Plumbing Regulation. While the majority of these municipalities are rural in nature, complaints are, nevertheless, received from home owners and others concerning the lack of this service. Experience has proven that only direct contacts with councils are effective in promoting new programs. To this end, a regional advisory service is being planned.

A number of major revisions were incorporated into the Plumbing Regulation, with the efforts of the Plumbing Advisory Committee and its technical committee being directed to reviewing new plumbing materials, and recommending additional revisions to the code.

Great Lakes Sampling



Watercraft Pollution Control

The new Ontario (Marina) Regulation which was brought into existence in June 1970 enhanced the Commission's Watercraft Pollution Control Program which came into operation on January 1, 1969. The Marina Regulation requires litter containers to be provided for boaters at all marinas. In addition, all commercial marinas must provide pump-out services. One hundred and forty-two marinas and yacht clubs were offering such service by the end of the 1970 boating season as compared to 91 pump-out facilities at the end of 1969.

Thirty-one hundred pleasure boats were inspected in 1970 compared to 1,765 in 1969. Three prosecutions are underway and three others are pending.

Inspections were made of commercial vessels in winter lay-up ports relative to the disposal of seacock filler.

Ice fishing areas were surveyed and a draft of a proposed regulation was prepared, covering the disposal of garbage and sewage associated with ice fishing huts.

Staff are working with joint Canada-U.S. Committees formed to establish compatible legislation on pollution from both pleasure craft and commercial vessels, and to prepare a "State-of-the-Art" report on sewage treatment and disposal aboard vessels.

REGIONAL SERVICES PLANNING BRANCH

The activities of the Branch can be divided into four general categories:

- the preparation of preliminary engineering reports;
- the participation in government interdepartmental committees and task forces involved in the preparation of provincial and regional plans;
- the evaluation of planning, development, and servicing proposals presented by other government agencies, municipalities, planning

boards, consulting engineers and developers;

- the provision of assistance to other branches and divisions in the Commission which are responsible for implementing the Branch's reports or other interrelated projects.

The Province of Ontario - Southwestern Area Water Supply Study was completed towards the end of the year. The report should be ready for limited distribution early in 1971. The technical background information for the Grand River Water Pollution Control Study and the Halton-North Peel Water Supply and Pollution Control Study was gathered. These studies will be continuing during the coming year.

By the end of the year the Branch was participating, on a regular basis, in fifteen committees and task forces concerned with such subjects as the Waterloo-South Wellington Area Study, Oshawa Area Planning and Development Study, Haldimand-Norfolk Planning and Development Study, airport expansion, regional government, Metropolitan Toronto Waterfront Plan, Metropolitan Toronto Official Plan, multiple-use service corridors, and the Toronto-Centred Region development concept. With the continued development of the horizontal form of government, there is every indication that the Branch will be contributing even more time to this type of activity in the future.

One of the more outstanding work groups in which the Branch participates is the Liaison Committee for Central and Southwestern Ontario which, more or less, succeeds the Goals Plans Committee of the Metropolitan Toronto and Region Transportation Study. This newly-formed committee is responsible to the Advisory Committee on Regional Development which is a deputy ministers committee endeavouring to co-ordinate programs for economic planning and development in the Province. The Branch first started participating in the Liaison Committee and three of its

four task forces in June of this year and has since attended a total of 47 meetings. Besides attending these meetings, there has been a substantial amount of "inshop" work required in preparing submissions, providing assistance, and maintaining preparedness. All this effort has produced results in the form of nine reports dealing with the following subjects: target populations for the South Peel and York Central Areas; the location of various sections of the Parkway Belt in Burlington, Mississauga, Etobicoke, and Vaughan; the proposed right-of-way from Nanticoke to Pickering for Ontario Hydro's 500 Kv transmission lines; and an evaluation of a proposed scheme for the disposal of cooling water from the Nanticoke Generating Station.

The providing of assistance to various branches and divisions of the Commission, as well as to management, continued at an increased rate from the previous year. At the request of the Division of Project Development, a water supply system from Nanticoke to Brantford was designed and costed. This information was employed by that division in formulating rate proposals to the area municipalities. Information was also provided to the aforementioned division relative to the areas suggested for hearings under Section 46 (a) of the OWRC Act. These areas included Colchester-South Harrow, St. Clair Beach-Tecumseh, Southern Kent County, Kingston, Port Hope-Cobourg, Deseronto-Napanee, Nanticoke, and Hamilton-Wentworth. Data on land use and population projections for the Ottawa River Study were correlated with that provided by the Quebec Water Board and the results were submitted to the Water Quality Surveys Branch for inclusion in the study report. Information regarding such items as the Metropolitan Toronto Waterfront Plan, the Mid-Western Ontario Development Area, and the South Peel and Lincoln County provincial schemes was also assembled and relayed to management.

WATER QUALITY SURVEYS BRANCH

The planning of water quality management programs and related pollution controls in the drainage basins of Ontario is the responsibility of the Water Quality Surveys Branch. This includes studies of drainage basins and analysis of ecosystems and their responses to wastes, surveillance and monitoring of inland streams, the shore waters of the Great Lakes and their connecting channels, and studies of proposals for dredging. Inventories are maintained of municipal, industrial and other sources of pollution in relation to trends in water quality in Ontario lakes and rivers and evaluations are made of the quality of water for water supply and wastewater discharge purposes. The planning and development of improved waste controls are based on engineering and scientific studies and lead to reports on water quality, waste loadings and their effects on water use. The object is to develop water quality standards and effluent requirements for municipalities and industries in implementing the Commission's "Guidelines and Criteria for Water Quality Management in Ontario". Investigations into the distribution of mercury and other environmental toxicants, the establishment of a contingency plan for the spill of oils and other hazardous materials and the surveillance of dredged materials resulted in increased activity within the Branch. Monitoring is carried out in those locations where active and potential use of water may affect its quality. Annual publications of the collected data are released to water managers and other interested persons.

Re-organisation took place early in 1970 with the Branch being divided into four sections, "Water Quality Control and Basin Planning", "Surveys and Investigations", "Interagency Technical Co-ordination", and "Technical Services". The activities of these sections are as follows:

WATER QUALITY CONTROL AND BASIN PLANNING SECTION

The Water Quality Control and Basin Planning Section plans and co-ordinates the development of studies and reports on drainage basin problems and evaluates compliance of proposals for waste treatment with water quality standards. This section advances solutions to water pollution problems and defines waste loading limitations to ensure restoration and maintenance of water quality conditions.

Radiological

The summary report on "Water Pollution from the Uranium Mining Industry in the Elliot Lake and Bancroft Areas" was completed, following a three year investigation. This report, scheduled for publication early in 1971, reviews the effects on the environment of radioactive and chemical pollutants and defines the measures necessary to control water pollution. It will provide a basis for evaluation of future uranium mining operations and waste treatment requirements. A second technical supporting volume will be released later in 1971.

Drainage Basin Studies

Major drainage basin planning reports for the Ottawa and Grand rivers were in progress during the year and a water planning study for the Thames River Basin was initiated. The Rainy River report was completed and submitted to the International Joint Commission.

Ottawa River Basin

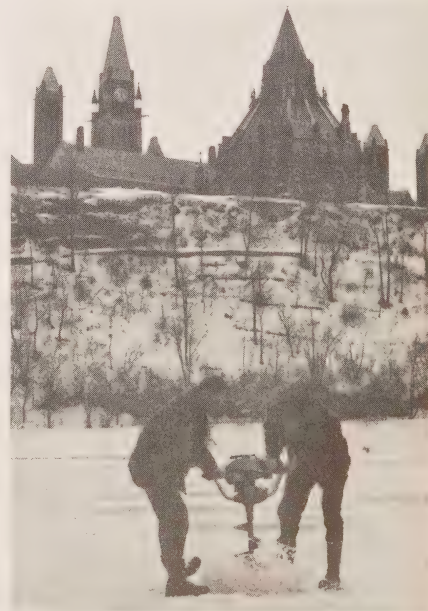
The report on the Ottawa River Basin study, conducted jointly by the Ontario Water Resources Commission and the Quebec Water Board, was well advanced in 1970 and scheduled for publication in February 1971. Completion of the Report in 1970 was delayed as a result of the priority given to the

mercury investigations. The report includes water quality standards for the river as well as a water quality control plan providing solutions for restoring and maintaining the water quality.

Grand River Basin

The interim report "Wastewater Loading Guidelines for the Grand River Basin" was prepared for publication in January 1971. It reviews the water quality problems of the drainage system, with particular emphasis on nutrient enrichment and on the response of the Grand River, in the major urbanized areas, to treated wastewater loadings. The Branch is contributing to a comprehensive basin survey and report due in 1971 on long-term water management of the Grand River. The report will review alternatives for water supply, water quality, flood control and variations related to the many uses of the river.

Ottawa River Survey



Thames River Basin

A water use planning study in the Thames River Basin was initiated in 1970 and is expected to continue over the next three years with the eventual publication of a report on recommendations for long-term water management. The report will lead to the development of water quality standards for the river as well as a water quality control plan providing effective solutions for the restoration and maintenance of water quality related to the many uses of the river.

Rainy River

The "Report to the International Joint Commission on the Rainy River — Water Use and Water Quality" was completed and submitted to the International Rainy River Water Pollution Board in the spring. This is a co-operative report of the Canada Department of National Health and Welfare, the U.S. Department of the Interior (F.W.Q.A.) and the State of Minnesota Pollution Control Agency, and was co-ordinated by this Branch. The conclusions and recommendations of the Report were included in the Ninth Progress Report to the International Joint Commission in April, 1970.

Water Quality Standards

In the implementation of the "Guidelines and Criteria for Water Quality Management in Ontario", proposals for effluent discharges are evaluated by the Branch and restrictions for treated wastewater loadings, consistent with maintenance of the water quality standards, are determined. The policy and criteria for use of natural waters to receive treated wastes were published in mid-1970.

Waste treatment evaluations were made at 40 existing and proposed municipal and industrial waste treatment discharge locations in the Province.

Waste Input and Pollution Abatement Inventory

An inventory is maintained of all industrial and municipal waste sources, proposed programs for pollution abatement and the expected completion date of these programs in the Great Lakes drainage basin and elsewhere in the Province.

SURVEYS AND INVESTIGATIONS SECTION

The Surveys and Investigations Section carried out fieldwork in 1970 for drainage basin studies, environmental system response studies, surveillance and monitoring of the Great Lakes and their connecting channels and the inland streams. Other work included evaluation of dredging proposals and investigations of spills of oil and other hazardous materials. A particular effort was devoted to investigations into the distribution of mercury and other toxic pollutants. Priorities were reassigned in the light of the urgency of the mercury

investigations and this resulted in delays in several on-going routine studies.

Mercury

Early in 1970 mercury pollution in Ontario held the spotlight. Investigations into the distribution of mercury and other toxic pollutants were carried out, with priority being given to the St. Clair River and the Wabigoon River. Extensive sampling of water and sediments for mercury contamination was carried out throughout the Province. The watercourses examined included the Wabigoon River, Kaministiquia River, Thunder Bay, Moberly Bay, Peninsula Harbour, lower Lake Huron, St. Clair River, Lake St. Clair, Detroit River, western Lake Erie, lower Niagara River, western Lake Ontario, Hamilton Harbour and the St. Lawrence River.

Extensive surface sediment and core sampling was undertaken in the St. Clair River — Lake St. Clair area where a total of approximately 400 dredge and core samples were collected.

Drainage Basin Studies

Major studies were under development during the year on the Thames River, the lower Kaministiquia River, including Thunder Bay, and the Kapuskasing River. Other surveys to evaluate the effects of municipal wastewater discharges on water quality were carried out on the Otonabee River below Peterborough, the Scugog River below Lindsay, Twelve Mile Creek at St. Catharines, the Boyne River below Shelburne and the Des Jardin Canal at Dundas. These data were used to prepare schedules of restrictions for treated wastewater loadings from municipal and industrial sources to ensure water quality conditions compatible with existing and future water uses.



Kaministiquia River — Thunder Bay Study

The Kaministiquia River — Thunder Bay study encompasses an evaluation of the waste discharges from the Great Lakes Paper Company Limited on the Kaministiquia River and Thunder Bay, and a water quality study in the vicinity of the three pulp and sulphite mills which discharge to Thunder Bay. The program includes definition of the distribution of bottom sediments (wood fibres) in Thunder Bay and the effects of the disposal of dredging on water quality and water use. The ultimate goal is to define the waste treatment requirements for the four pulp and paper mills in the Thunder Bay area and to minimize damage to water quality resulting from the disposal of dredgings. The study, to be continued in 1971, will also provide guidelines for the location of future water supply intakes and treated wastewater outfalls to serve the City of Thunder Bay and surrounding areas. Work is progressing on the analysis of the water quality data collected in 1970.

Kapuskasing River Study

The Kapuskasing River Study was designed to evaluate the effects of the wastewater discharges from the Spruce Falls Power and Paper Company Limited at Kapuskasing on the quality of the Kapuskasing and Matagami rivers. The survey, conducted in September, extended over 60 miles of river. A report on the findings will be completed early in 1971.

Investigations of the water quality and the sediments of Lake Superior were carried out at Terrace Bay and Marathon, Ontario. The purpose of these studies was to determine the effects of the wastes from the pulp and paper industry at Terrace Bay and from the pulp and paper and associated chlor-alkali industries at Marathon.



Water Current Studies

Surveillance and Monitoring

Information on water quality of inland lakes and streams and the Great Lakes and interconnecting channels was collected, processed and reported. The monitoring program is used to acquire information on developing problems and to assess compliance of waste discharge sources with the water quality standards. Sampling was carried out at 650 locations on 137 rivers and at 2000 locations on the Great Lakes and connecting channels. This may be compared to about 200 locations in 1964 when the routine monitoring program commenced. The OWRC was assisted in the collection of samples in the inland lakes and streams by local conservation authorities, health units and the Ontario Department of Lands and Forests. In the Great Lakes Program, two cruises of problem areas in lakes Erie and Ontario and one on Lake Huron-Georgian Bay were completed. Monitoring of the interconnecting channels was also carried out with four surveys on each of the St. Marys, St. Clair, Detroit and Niagara rivers and two surveys on the St. Lawrence River. Aerial and vessel surveillance on sources of waste and for the presence of oil and other material spills was maintained.

As an input to the International Hydrological Decade (1965-1974), a program designed to assess regional and

world-wide water resources, special water quality sampling and analysis were carried out at 33 locations throughout Ontario.

Carbon adsorption units were maintained in operation at six locations on the Great Lakes from Sault Ste. Marie to Cornwall to provide information on trace organics. The automated collection (robot monitoring) system was continued at two locations on the Ottawa River and one on the St. Clair River. Continuous records of dissolved oxygen, temperature, pH conductivity and chlorides are provided by these units.

Environmental Systems

The environmental systems program consisted of two phases namely, the installation and operation of recording type meters and mathematical data reduction. Meters were installed in Lake Ontario in the vicinity of the Lakeview water pollution control plant, and off Prince Edward County in the vicinity of the proposed Belleville-Trenton waterworks intake site, and the outfall from a proposed kraft mill. Studies were also conducted in the vicinity of the proposed outfall of the Central York water pollution control plant located near the outlet of the Rouge River. Work was initiated in Cook Bay of Lake Simcoe to determine the best possible relative location of a treated sewage outfall and water intake.

Data on water movement required for the optimum location of waste outfalls and water intakes were obtained by instrumentation in these areas. Mathematical modelling of current meter data was extended to predict hourly dispersion patterns in the lakes. A model was developed from field survey data to estimate the physical extent of thermal cooling water plumes on lakes and a preliminary numerical model was also developed which determines water chemistry concentration contouring in the nearshore areas of lakes.

Dredging

The disposal of dredged materials in the Great Lakes and inland waters requires close surveillance, as these materials may contain any number of elements deleterious to water quality, including mercury, zinc, cadmium, selenium and copper. As in the case of mercury-laden sediments, dredging techniques and areas of disposal have to be chosen carefully and monitored continuously.

Since the release of the IJC Report, many proposals for dredging have been submitted to the OWRC from the Canada Department of Public Works and Ministry of Transport, the St. Lawrence Seaway Authority and others for review and comments. Fifty-five proposals were evaluated and in the course of these evaluations, sediments were examined at Thunder Bay, Sault Ste. Marie, Grand Bend, Kingsville, Leamington, Port Stanley, Niagara-on-the-Lake, Hamilton, Oshawa, Kingston and Cornwall.

Contingency Plan

In July 1970 the "Lake Erie Contingency Plan" was published to document a system for the notification, containment and clean-up of spills in this body of water resulting from the transportation, storage and other handling of oil and hazardous materials. Subsequently, a draft of the "Province of Ontario Contingency Plan for Spills of Oil and Other Hazardous Materials" was prepared for review within the OWRC and by outside agencies and organisations which will supply the needed resources to make the plan operate effectively.

The organisational and liaison centre for the contingency plan is the "Ontario Operations Center" which co-ordinates the notification and counter-measure response following discovery and alerting actions. Spills of oil and other hazardous materials are reported to the Center which maintains communication necessary to mobilize avail-

able resources towards the control, containment and clean-up of spills.

INTERAGENCY TECHNICAL CO-ORDINATION SECTION

Various meetings with Federal, Provincial, State and other agencies were attended. Noteworthy were the Great Lakes Conference, the Canada-U.S. Working Group on Great Lakes Pollution and the legislative Committee on Lake Erie. In addition, meetings with several other agencies listed were attended.

The Great Lakes Environmental Conference, convened by Ontario, was attended by the eight Great Lakes States and the provinces of Ontario, Manitoba and Quebec. The latter two provinces and the two federal governments were present as observers. The states and provinces reaffirmed their total commitment to achieve improved environmental quality in the Great Lakes Basin. An Action Committee of senior governmental officials was established to encourage integrated surveillance and reporting and act as a forum to review environmental quality standards and achieve compatibility of standards and enforcement. The Committee met twice during the fall of 1970 in anticipation of a second convening of the Governors and Prime Ministers in 1971.

The Canada-U.S. Working Group on Great Lakes Pollution representing the two federal governments, and the governments of Ontario and the Great Lakes States, was established at a ministerial meeting in Ottawa in June 1970. The objective of this international Working Group is to continue discussions towards the implementation of the recommendations of the reports of the International Joint Commission on pollution in the lower Great Lakes and the international section of the St. Lawrence River. Ten sub-groups were established by the Working Group to consider major elements which might be

included in new co-operative arrangements for more effective water pollution control by the governments in the Great Lakes region. Based upon the findings of the sub-groups, consideration will be given to the following key aspects utilising an agreed international framework:

- (1) the adoption of common water quality objectives for the Great Lakes by all authorities concerned;
- (2) an exchange of commitments among the governments to carry out programs and other measures required to achieve common goals; and
- (3) the development of suitable arrangements to assist and supervise the carrying out of agreed programs.

Representatives of the Commission attended meetings of the Legislative Committee on Lake Erie. The Committee is composed of elected representatives from the states of Michigan, Ohio, Pennsylvania and New York, which border Lake Erie, having as its objective the exchange of information and co-ordination of legislative activities aimed at improving the environmental quality of Lake Erie.

While Ontario is not a member of the Committee, from time to time the OWRC meets with this Committee to discuss mutual problems and endeavours to develop co-operative programs. Presentations were made by Commission representatives on sections of The Ontario Water Resources Commission Act, which give the Commission comprehensive authority to assist municipalities, industries and persons with water supply and pollution control problems. The pollution abatement programs for Lake Erie that are underway or being considered, and the programs and policies of the Commission were also presented.

The Branch is active in several technical committee and interagency study programs which include the following:

Division of Water Resources

K. E. Symons, Director
D. N. Jeffs, Assistant Director



Great Lakes Survey
Advisory Boards to International Joint
Commission:

Advisory Board of Control of Pollution of Boundary Waters:

- Water Quality Objectives Committee

Rainy River Water Pollution Board:

- Working Group on Survey and Report on Water Use and Water Quality in the Rainy River

Great Lakes Levels Reference:

- Liaison with Shore Properties Sub-Committee

Canadian Committee on Oceanography:

- Great Lakes Working Group

Great Lakes Study Group:

- Scheduling and Facilities Committee

Great Lakes — Upper Mississippi River Board:

- Committee on Water Quality Management Data Handling

Deputy Minister's Advisory Committee on Pollution Control:

- Sub-Committee on Radio-activity

OWRC Water Quality Objectives Committee

Nanticoke Development Committee
University of Guelph Committee on
Utilization of Animal Wastes

U.S. Federal Water Quality Administration:

- Liaison Technical Committee on Water Quality Guidelines for Lake Superior

Ontario Department of Highways:

- Salt Contamination Committee

Canada-U.S. Working Group:

Secretariat and Sub-Groups on:

- Water Quality Objectives and Standards
- Contingency Plans
- Pollutant Materials: Handling Hazards (on Water)
- Institutional Matters
- Co-ordination of Action to Meet Special Situations
- Pollution from Agricultural, Forestry and Conservation Sources

TECHNICAL SERVICES SECTION

The Technical Services Section provides the supporting marine operations and instrumentation services for the Surveys and Investigations Section and also maintains the general office and draughting services. Six survey vessels were operated on the Great Lakes and interconnecting channels in conjunction with three service vehicles. Specifications were prepared for a second large survey vessel, including negotiations for the purchase of a 33.5 ft. launch. Six carbon adsorption units and three robot water quality stations were maintained in operation. In connection with the current meter and submersible water quality stations, assistance was also given with installation and necessary maintenance of these instruments.

One hundred and ninety-four projects were completed by the Draughting Office. The Office Services maintained budget control, requisition of supplies, recording of data from the radiological and mercury investigations, secretarial, stenographic and general office support for the Branch.

The Division of Water Resources is responsible for the inventory, assessment and management of surface and ground water resources with respect to quantity, and also for the protection of ground-water quality. The programs are carried forward through four branches and include the collection, analysis and publication of basic hydrometric and hydrologic data, the assessment of water resources through surveys and interpretation, the development of water supplies by test-drilling and well-construction projects, the management of resource use through a water-permit system, the regulation of the water-well industry, and scientific hydrologic studies. These programs include regulatory and inventory assignments.

The work of the Division is described according to broad divisional as well as specific branch activities. Attention is directed to the substantial increase in investigations related to ground-water pollution.

Cartography

The Cartography Section supports the programs of the Division by preparing maps, charts, and diagrams; by procuring from a variety of sources, maps, plans, aerial photographs, and mosaics, and by providing or arranging for the reproduction of these for internal and publication purposes.

Maps compiled or published in 1970 included: Lambton County Ground Water Probability, Kent County Ground Water Probability, Northern Ontario Hydrometric Stations and Investigated Sites — 1969, and Lake Ontario Drainage Basin Bedrock Well Yields.

ARDA Projects

The Water Resources Survey of the Big Creek Drainage Basin which qualified for support under the Agricultural Rehabilitation and Development Acts, was finalized and publication was arranged.

International Hydrological Decade

The International Hydrological Decade, 1965 to 1974, is a world wide program designed to advance the science of Hydrology and the assessment of regional and global water resources. Several activities of the Division have been recognized as being contributions to the program. These include the studies by the River Basin Research Branch of Hydrologic characteristics of five representative river basins in southern Ontario and the assessments of ground water and of surface water by the Hydrologic Data Branch through its regular inventory programs.

The International Field Year on the Great Lakes is a special water balance study in the Lake Ontario basin involving many disciplines and agencies. The River Basin Research Branch continued to study the ground-water contribution to the lake from Ontario and became involved in methodology and ground truth in relation to remote sensing techniques.

The Decade programs were also supported through representation of the Ontario Committee for International Hydrological Decade and its scientific and educational sub-committees and on the Working Group on Terrestrial Water Balance and associated sub-groups set up to plan and co-ordinate the work of the International Field Year on the Great Lakes.

Northern Ontario Water Resources Studies

The Division continued its inventory and assessment of the water resources of northern Ontario. The Hydrologic Data Branch continued with the collection of basic hydrometric data through its own activities and through co-operation with the Water Survey of Canada, a section of the Inland Waters Branch, federal Department of Fisheries and Forestry, and the Meteorological Branch, federal Department of Transport. The Surveys and Projects Branch

proceeded with studies of water quality and hydrologic characteristics. While field studies were continued, more effort was directed to modelling or simulative techniques.

The Division participated in the work of the Federal-Provincial Co-ordinating Committee on Northern Ontario Water Resources Studies. Close co-operation was maintained through this Committee through a Working Group comprised of representatives of federal and provincial agencies contributing to the studies, and by means of previously-established working arrangements.

Data Processing Activities

Through a divisional liaison officer, close co-ordination was maintained with the Systems and EDP Branch of the Division of Administrative Services, and this continued to be effective in the examination, planning, development and implementation of computer-oriented systems and programs to meet divisional needs. Significant progress was made in the development and operation of the Water Well Record System, the Streamflow Data System and the Storet System. Computer programs of a scientific nature were developed and used to aid in studies related to hydrology, hydrogeology and geophysics.

SURVEYS AND PROJECTS BRANCH

The Surveys and Projects Branch conducted municipal ground-water surveys, municipal test-drilling and well-construction projects, drainage basin surveys, and special investigations of ground-water pollution and water-supply problems. It also participated in regional water-resource studies.

A significant increase was experienced in the requests for advice and investigations related to potential and actual ground-water pollution problems. Under new formal arrangements, ad-

visory or consultative services were provided to the Waste Management Branch, Department of Energy and Resources Management, with respect to the hydrogeological suitability of waste disposal sites and to the Petroleum Resources Section, Department of Mines and Northern Affairs, with respect to the location, construction, operation and monitoring of deep disposal wells. Opinions were also provided to other divisions on certain municipal and industrial sewage disposal works, such as sewage lagoon sites.

Studies completed or in progress included four drainage basin surveys in southern Ontario, the Northern Ontario Water Resources Survey, four regional studies, 25 municipal ground-water surveys, four test-drilling or well-construction programs, and 131 special investigations comprised of 73 pollution investigations and 58 water-supply investigations. Tables 1 and 2 and Figure 1 present a summary of these activities.

Northern Ontario Water Resources Survey

Work continued on the quantitative and qualitative assessment of water resources in northern Ontario.

With regard to surface-water runoff, studies continued on the testing and the development of methods for establishing the relationship between runoff and precipitation at stations where long-term data were available, in order to be able to estimate runoff for areas of short-term data. Existing methods of calculating runoff are not necessarily valid under northern conditions.

The assessment of ground-water resources continued through test drilling and collection of hydrogeologic and well data in the field. Analysis of data was supported by the development of computer programs. Field work was concentrated in the Albany and Moose River basins.

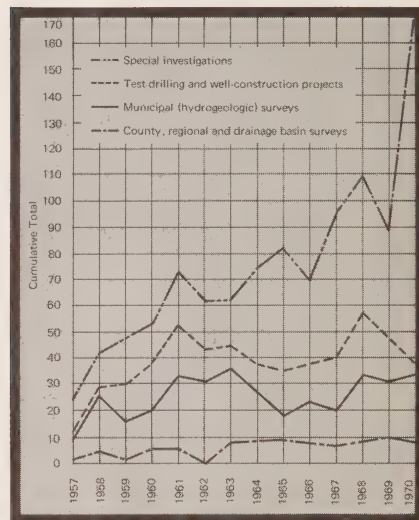
A surface-water sampling program was initiated in the western portion of

TABLE 1
SUMMARY OF SURVEY ACTIVITIES – 1970

Activity	Survey Status		Report Status	
	Initiated	Completed	In Progress	Released
Northern Ontario Water Resources Survey	X			
Drainage Basin Surveys				
Big Creek		X	X	
Moira River	X		X	
Upper Nottawasaga River		X	X	
Rouge River-Duffin Creek	X			
Regional Studies				
Counties of York and Ontario – Northern Area	X			
County of Halton	X			
Grand River	X			
Niagara Peninsula		X	X	
Municipal Ground Water Surveys				
Ayr*	X			
Braeside*	X		X	
Burlington		X	X	
Casselman*		X		X
Creemore		X		X
Drury, Denison, Graham and Waters Township*		X		X
Dryden		X	X	
Embrun*		X		X
Finch*	X			
Frankford		X	X	
Ignace*	X			
Kimberley		X	X	
Lansdowne*		X		X
Markdale		X		X
Maxville*		X		X
Melbourne*	X			
Merrickville		X	X	
Noelville*		X		X
Ottawa-Carleton		X		X
Plantagenet*	X			
Rodney	X			
Stirling		X		X
Sydenham*		X		X
Thamesville*	X			
Wasaga Beach		X	X	

* Proposed provincially-owned system

Fig. 1
Active and Completed Surveys, Projects and Investigations



the study area to provide data on the chemical and biological quality of the waters.

Drainage Basin Surveys

Work proceeded on water resources studies of four drainage basins in southern Ontario. The surveys cover the availability and quality of water resources in the basin, uses of water and opportunities for resource development and management. The report on the Big Creek basin was finalized and publication was arranged; a draft report was completed for the Upper Nottawasaga River basin; field work and report preparation continued for the Moira River basin, and planning for the study in the Rouge River-Duffin Creek basins was completed and test drilling initiated.

Regional Studies

Office and field studies were in progress to determine the availability of ground-water and surface-water re-

sources for four regions of the Province: the Counties of York and Ontario — Northern Area; the Niagara Peninsula; the County of Halton and region; and the Grand River basin. The results of the studies are to be incorporated by the Division of Sanitary Engineering in reports on regional water-supply and/or pollution control requirements. Material for the Grand River basin regional study will also be utilized in a planning report to be prepared by the Treasury Board.

Municipal Ground Water Surveys

The Branch was engaged in 25 surveys to evaluate ground-water conditions for municipal water-supply purposes. Eight of the surveys were continued from the previous year and 17 new surveys were initiated. Eleven ground-water survey reports were released. Poor-to-marginal prospects for ground-water supplies were reported for the Township of Drury, Dennison, Graham and Waters (Whitefish and Naughton), Noelville, Casselman and Maxville. Favourable conditions for the development of municipal ground-water supplies were indicated for seven municipalities.

The report prepared for the Regional Municipality of Ottawa-Carleton was in response to a request for an assessment of ground-water conditions to assist the Regional Municipality in its area planning studies. This report included specific information for 24 communities within an area of about 1,100 square miles.

Test Drilling and Well Construction Projects

The Branch participated in three test-drilling projects and one combined test-drilling and well-construction project. One of the test-drilling projects had been carried forward from the previous year and reports were released on all three. The Blezard Valley Area test-drilling and well-construction program was still active at the end of the year.

TABLE 2

SUMMARY OF PROJECT ACTIVITIES — 1970

Activity	Location	Field Work Active	Report Released	Test Wells	Completed Production Wells
Test Drilling	Fauquier		X	3	
	Glen Williams		X	4	
	Holtyre		X	7	1
Test Drilling and Well Construction	Blezard Valley Area	X		20	5

The total price of approved contracts amounted to \$142,389. Several projects were in pre-contract stages.

Test-drilling projects located suitable water supplies at Holtyre and Blezard Valley. Efforts were unsuccessful in locating sufficient supplies at Glen Williams and Fauquier. All contracts were for provincially-owned systems.

Special Investigations

Seventy-three investigations into existing or potential ground-water pollution problems were completed or were in progress. Five investigations were carried forward from the previous year and 25 were in progress at the end of the year. Forty-eight reports were released. Fifteen investigations involved waste disposal sites and were referred to the Branch by the Waste Management Branch of the Department of Energy and Resources Management.

Fifty-eight investigations into water-supply problems and well-performance evaluations were in progress or completed. Five investigations were carried forward from the previous year and 15 were in progress at the end of the year. Forty-three reports were released. Nineteen of the investigations involved testing project wells and analyzing well and aquifer performance to provide advice to the Division of Plant Operations on changes in production potential.

WATER AND WELL MANAGEMENT BRANCH

The activities of the Water and Well Management Branch were carried out under two programs: water management and well-construction management.

The main activities under the water-management program included processing applications and permits for the taking of water, investigating and reporting on complaints concerning alleged interference with water supplies and enforcing associated legislative and permit requirements. In addition, an increase in complement permitted the implementation of water-use studies as part of the water-management program.

Under the well-construction management program, activities mainly concerned licensing water-well contractors, checking locations of new wells and their sanitary construction, and investigating complaints against water-well contractors and possible infractions of statutes and regulations.

Figure 2 shows graphically the number of surface-water and ground-water interference investigations carried out each year since 1961 and well-construction investigations since 1965.

WATER MANAGEMENT PROGRAM

Applications and Permits

Table 3 contains a summary of

water-permit data for 1970. Of the 451 permits issued, 249 were for irrigation purposes, 41 for municipal-supply purposes, 76 for industrial purposes, 7 for commercial purposes and 78 for recreational purposes. A total of 189 permits were cancelled, mostly because of a change in ownership of properties, and 166 permit amendments were authorized by the Commission.

Table 4 indicates the number of permits issued and the maximum daily amounts of water takings authorized in 1970, according to drainage basin, source and purpose. Table 5 contains a summary of amounts of water taking approved annually since 1961. Figure 3 shows graphically the amounts and purposes of surface-water and ground-water takings authorized since 1961. The large increase in the amount of water authorized from surface sources in 1970 was due largely to approval under two permits of the use of 4,655 million gallons per day for cooling purposes at thermal generating plants.

Fig. 2
Types of Investigations

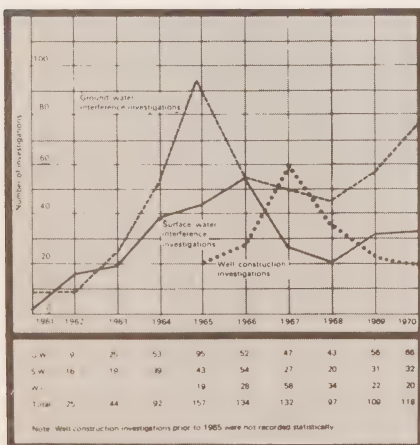


TABLE 3
SUMMARY OF WATER PERMIT DATA FOR 1970

SOURCE	APPLICATIONS						
	Carried Forward From 1969	Received in 1970	Refused Withdrawn or not Required	APPROVED By Letter	By Permit	Under Consideration on December 31, 1970	Amount of Water Taking Approved by Permit* (MGD)
Ground Water	3	117	12	44	57	7	19.92
Surface Water	20	426	24	—	388	34	5,013.82
Ground and Surface Water	1	11	6	—	6	—	1.80
Total	24	554	42	44	451	41	5,035.54

*Does not include water takings approved by letter of approval or by permits where conditions of taking rather than amounts were specified.

Renewal Applications and Permits

One hundred and fifty-eight renewal applications for Permits To Take Water were received during the year, and one application was carried forward from 1969. By December 31, 1970, 147 permits had been renewed, eight applications had been withdrawn, and four applications remained under review.

Water Management Investigations

Ninety-eight ground-water and surface-water interference problems were investigated during the year, an increase of eleven from 1969. The problems, based on alleged and actual causes, can be classified as follows: gravel-pit and quarry operation — 19; excessive recreational storage of water — 16; municipal withdrawals — 16; road, sewer and watermain installation — 11; irrigation withdrawals — 11; and miscellaneous — 15.

Ground Water Interference Investigations

Sixty-six investigations of ground-water interference problems were carried out and reports were completed for 60 of the problems during the year.

Some of the investigations required repeated field trips to assemble sufficient data to clearly establish causes and responsibilities.

The municipalities in which investigations were carried out are indicated below. The figures in brackets indicate the number of separate complaints when more than one was investigated.

Townships: Albion, Blanshard, Brantford, Caledon, Chinguacousy, Collingwood, Cumberland, Delaware (2), East Gwillimbury, East Nisouri, Ernestown, Galway, Lobo (2), London, Louth, Maidstone, Markham (3), Mono (3), North Dumfries (3), North Elmsley, North Grimsby, North Norwich, Oso, Pickering, Raleigh, Saltfleet, Sarnia, South Dumfries, South Monaghan (2), Tyendinaga, Vaughan (2), Vespra, Waterloo (2), West Flamborough, West Hawkesbury, Westminster, West Oxford (3), Wilmot, Woodhouse (2), Yarmouth.

Towns: Acton, Bradford, Kapuskasing, Mississauga, Pembroke, Stayner.

Regional Municipalities: Ottawa-Carleton (2), Niagara.

City: Sault Ste. Marie.

Borough: Scarborough (2).

TABLE 4

PERMITS ISSUED AND TAKINGS AUTHORIZED IN 1970 ACCORDING TO DRAINAGE BASIN, SOURCE AND PURPOSE

Drainage Basin	SURFACE WATER					GROUND WATER					COMBINED TAKING					TOTALS
	Comm.	Ind.	Irr.	Mun.	Rec.	Comm.	Ind.	Irr.	Mun.	Rec.	Comm.	Ind.	Irr.	Mun.	Rec.	
Ottawa River		7 .21	3 .34	1 .24			1 .02	1 .65	2 .24							15 1.70
St. Lawrence River				3 31.12			1 .24									4 31.36
Lake Ontario	2 .53	14 1,345.49	36 9.31	2 25.00	+24		9 5.91	1 .07	5 .56				1 .81	1 .04	1 .03	72 + 24 1,387.75
Lake Erie & Lake St. Clair		16 8.43	186 57.39	4 34.14	1 + 10 .03		3 1.08	6 2.04	7 4.34	3 .15			3 .92			229 + 10 108.52
Lake Superior		6 8.62			+ 1											6 + 1 8.62
Hudson Bay	1 .19	5 1.25		1 .01	+ 1				1 .02							8 + 1 1.47
Lake Huron	1 .25	13 3,385.81	12 2.21	2 103.25	+ 36	3 .40	1 .05		12 4.05	1 .10						45 + 36 3,496.12
Total	4 .97	61 4,749.81*	237 69.25	13 193.76	1 + 72 .03	3 .40	15 7.30	8 2.76	27 9.21	4 .25			4 1.73	1 .04	1 .03	379 + 72 5,035.54
Grand Totals			316 + 72 5,013.82					57 19.92					6 1.80			

NOTE: * Includes 2 takings totalling 4,655.00 MGD for cooling purposes at thermal generating plants.
 (i) In each square the number of permits issued appears above with the amount of authorized water takings in IMGD.
 (ii) The number following a "+" shows the permits issued under special conditions and having no rate or amount specified.
 (iii) Purposes: Comm. — Commercial; Ind. — Industrial; Irr. — Irrigation; Mun. — Municipal; Rec. — Recreational.

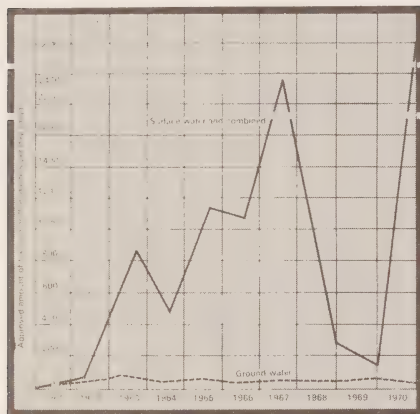
TABLE 5

SUMMARY OF AMOUNTS OF TAKING APPROVED BY PERMIT FOR VARIOUS PURPOSES

PURPOSE	1961 MGD	1962 MGD	1963 MGD	1964 MGD	1965 MGD	1966 MGD	1967 MGD	1968 MGD	1969 MGD	1970 MGD
Commercial	0.28	3.88	0.36	1.48	0.36	1.45	0.48	0.61	1.94	1.37
Industrial	10.34	10.45	26.38	329.14	947.91	1,310.08	2,238.94	55.58	53.85	4,757.11
Irrigation	0.38	8.88	774.09	51.49	134.82	94.23	96.46	69.11	86.18	73.74
Municipal	6.53	12.13	21.24	103.62	31.49	17.69	18.16	162.15	33.88	203.01
Recreation	—	—	0.93	0.23	0.05	0.07	4.31	0.02	0.18	0.31
TOTALS	17.53	35.34	823.00	485.96	1,115.63	1,423.52	2,358.35	287.47	176.03	5,035.54

NOTE: The amounts do not include water takings approved by letters of approval or by permits where conditions of taking rather than amounts were specified.

Fig. 3
Amount of Water Taking Authorized by
Permit According to Year and Source



The well-interference studies in the townships of Blanshard, Markham and West Oxford, and in the Town of Bradford were complex and required numerous field investigations. Studies were continued in the Glen Cairn and Kanata subdivision areas of the Regional Municipality of Ottawa-Carleton. Details of some of these studies follow.

Township of West Oxford — Several private well owners alleged that their water supplies had suffered serious interference as a result of nearby limestone-quarrying operations. An investigation was carried out in conjunction with a study requested by the Department of Mines and Northern Affairs into the extent, if any, of regional water-level lowering in the area. Difficulties in evaluating the problem relate to the history of operations of three separate quarries, the lack of historical water-level information, and the inaccessibility of most of the wells in the area. These difficulties have necessitated a continuance of the study.

Town of Bradford — The operation of a new high-capacity well by the Town of Bradford resulted in complaints of interference by several private

well owners. Such problems had been expected on the basis of pumping-test data previously submitted by the municipality, and the intensive water-level monitoring program which had been initiated in advance of the start of pumping in July, 1970. Water levels in the area appeared to have stabilized by the end of September. The Town of Bradford was advised verbally that the water supplies of three well owners were found to have suffered serious interference and that recommendations for compensation for costs incurred in restoring their water supplies would be forthcoming. Thirteen other wells ceased to flow due to operation of the municipal well, but sufficient lowering had not occurred to make the owners eligible for compensation. By the end of the year, a draft report on the investigation had been completed.

Surface Water Interference Investigations

Thirty-two investigations of complaints concerning interference with surface-water supplies or depletion of streamflow were made and reports were completed for all the investigations.

The municipalities in which investigations were carried out are indicated below. The figures in brackets indicate the number of investigations in municipalities where more than one problem occurred.

Townships: Brantford, Caledon, Darlington, East Flamborough, East Gwillimbury, Erin, Esquesing, Haldimand, Kenyon, King (2), Louth, Markham (3), Mono, Puslinch, Smith, Storrington, Vaughan (2), Whitby, Whitchurch, Yarmouth.
Towns: Burlington, Preston, Richmond Hill (2).

Cities: London, Waterloo

Water Use Studies

During the year, water-use studies were initiated, and water-taking investigations were expanded. A detailed study of water use in the Lynn River basin

was undertaken. This involved the compilation and evaluation of data already on file, as well as extensive field work which included five sets of streamflow measurements, a series of irrigation checks to assess the effects of such withdrawals on streamflow, and contacting many of the irrigators personally to stress the importance of maintaining accurate water-taking records. By the end of the year, data collection had been completed and work on a report on water use and water availability in the basin was near completion.

At the request of other branches of the Commission and other government departments, brief assessments of water use were completed for the Thames River, the Rouge River, and the Middle Grand River.

The compilation of basic water-use data was expanded. This involved the calculation of reported daily rates and amounts of taking submitted by permittees in several river basins in southern Ontario. A procedure was developed for such calculations to be performed on all incoming records as they are received. A suggested procedure for compiling past records and a format for presenting the data were developed.

During the year, 716 farms were visited. The watertaking practices of 84 permit holders were checked and 148 permit applications were obtained. In addition, 72 farm owners were visited specifically to obtain data required to process applications.

WELL CONSTRUCTION MANAGEMENT PROGRAM

Well Contractors

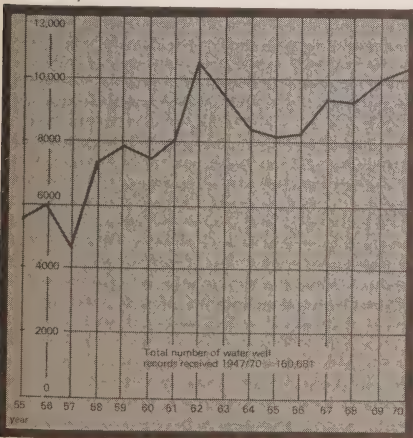
Three hundred and ninety-eight licences were issued in 1970 for the business of boring or drilling wells for water; 25 licences were issued to boring contractors and 373 licences were issued to drilling contractors. Records for 10,379 water-wells were received during 1970. The number of records received

annually for the years 1955 to 1970, inclusive, is shown in Figure 4. The inspectors visited water-well contractors on 1,027 occasions, checked the locations of 12,488 wells and made 1,312 inspections for sanitary well construction. The number of checks on well locations during the year was 5,455 greater than in 1969. This was achieved by the use of seasonal help.

During the year a drilling contractor was charged with drilling wells for water while not the holder of a licence from the Commission and was found guilty.

Members of the Branch staffed a display booth at the Canadian Water Well Contractors' Association Annual Convention, contributed an article for the official program and presented a talk at the convention technical session.

Fig. 4
Number of Water Well Records Received Annually



Investigations Concerning Well Regulations

Twenty investigations concerning well regulations were carried out during the year.

The municipalities where investigations were carried out are listed below.

Townships: Alfred, Bertie, Caledon, Chaffey, East Gwillimbury, Erin,

Esquesing, Georgina, Malahide, North Gwillimbury, Percy, Pickering, Reach, Sarnia, Sidney, Uxbridge, Walpole, Yarmouth.

Towns: Aurora, Burlington.

HYDROLOGIC DATA BRANCH

The activities of the Hydrologic Data Branch centered around the collection, analysis and distribution of hydrologic data, with emphasis being placed on the provision of basic ground-water and surface-water data for general and specific programs and for public purposes.

Observation Wells

The observation well network which is operated by the Branch to monitor ground-water level fluctuations throughout the Province was expanded to 196 wells by a net addition of 38 wells. Water-level recorders were operated on 79 wells and manual measurements taken at 117. Staff members made manual measurements at 21 wells, private citizens at 51, and other governmental or municipal employees at 45. Figure 5 shows the historical development of the observation well network.

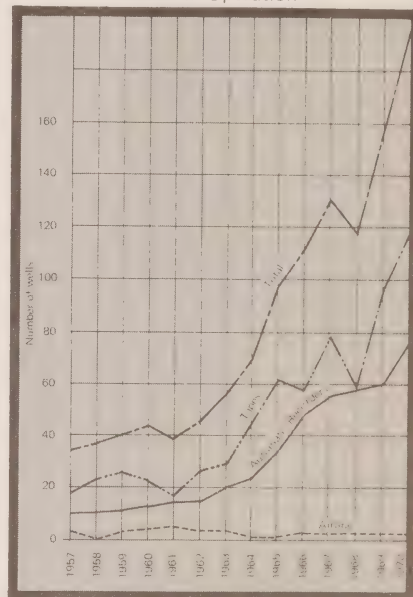
Additional observation wells were established to serve specific development or management needs. For example, water-level recorders were installed in three wells at sites under investigation for municipal well development and in two wells where there was a possibility of interference with private well supplies due to operation of high-capacity wells.

Hydrogeologic Data

An additional 4,000 water-well records received through the Water and Well Management Branch from water-well contractors were placed on open file. Water Resources Bulletin 2-7 in the ground-water series was published, proof copies of Bulletin 2-8 were received from the printer and publication was set for early 1971. These bulletins contain data abstracted from water-well records for the years 1960 to 1964, inclusive, and cover the south-central

and southeastern areas of Ontario respectively.

Fig. 5
Observation Wells in Operation



The work of converting the system of water-well records and their data from a manual file to an electronic data processing system continued through the employment of a special work force. Of the 150,000 water wells on record, 130,000 have been processed for storage on the computer file. Processing of the remaining 20,000 records was in progress and was scheduled for completion in March 1971. A retrieval program was developed with the Systems and EDP Branch, Division of Administrative Services, for the retrieval of data for the publication of the bulletins and was ready for testing at the end of the year. Co-operation and assistance in this program was received from the River Basin Research Branch, the Water and Well Management Branch and the federal Inland Waters Branch.

A map showing the probable ground-water yield for the County of Lambton was published and distributed. Compilation of a similar map for the County of Kent was completed and printing and distribution are scheduled for early in 1971. Another map for the County of Essex was under preparation and is scheduled for distribution in late 1971.

Public Enquiries

There was a considerable increase in the demand for hydrogeologic information. As a result of public enquiries, 209 summaries of ground-water conditions were prepared, 227 letters written, and 6,935 copies of water-well records were made available to 196 individuals who were interested in locating and developing ground water. Ground-water information was also provided through 753 telephone calls. Two hundred and three visits were made to the office by persons who consulted the records or discussed ground-water conditions with staff members.

Ground Water Assessment Program

Work proceeded on the assessment of aquifers in the Province through studies in four areas. A draft of the report "Aquifer Characteristics of the Guelph and Amabel Formations in the Township of Sullivan, Ontario" was completed. The report covers work initiated in 1967. Additional drilling was completed in the Township of Wainfleet to supplement earlier testing of aquifer conditions in the overburden and shale bedrock formations and data analysis was in progress. In the Township of Albion, six piezometers were installed at two drill sites, a pumping test was performed and a water quality survey was undertaken to evaluate aquifer conditions in the overburden and the Meaford-Dundas shale bedrock. In the Township of Pickering, five observation wells were constructed and a pumping test performed to study the characteris-

tics of the overburden aquifer in the area of the Claremont Conservation Park.

Surface Water Data and Studies

Streamflow data were assembled through gauging station and metering operations by the Branch and through co-operative arrangements with the Water Survey of Canada. A summary of streamflow gauging stations and operating agency is presented in Table 6 and a historical record of the types and numbers of streamflow stations operated each year since 1963 is shown in Figure 6.

At the request of the Branch, the Water Survey of Canada increased the number of streamflow gauging stations which it operates under a cost-sharing agreement from 61 to 74.

Of the 116 streamflow gauging stations operated by the Hydrologic Data Branch, the numbers of stations supporting various programs are: water quality monitoring — 72; drainage basin surveys — 8; water supply studies — 15; network and special studies — 21. During the summer months, 750 streamflow measurements were made at 102 other sites. Many of these sites were selected to meet specific data requirements.

In addition to the streamflow gauging stations, the Hydrologic Data Branch operates one recording lake gauge and the Water Survey of Canada, operates 2 recording and 3 manual lake gauges.

TABLE 6

SUMMARY OF TYPES OF STREAMFLOW GAUGING STATIONS BY OPERATING AGENCY

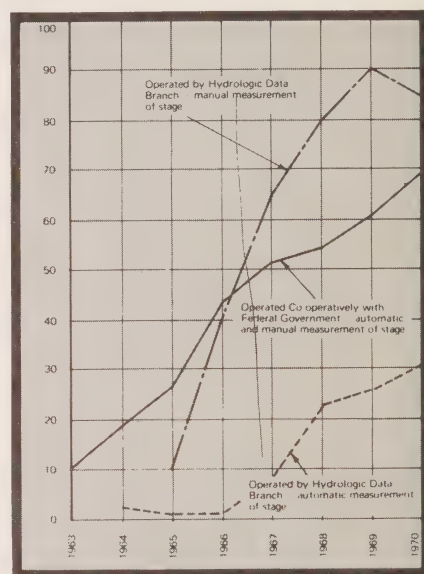
Operating Agency	St. Lawrence Drainage Basin		Hudson Bay Drainage Basin	
	Recording	Manual	Recording	Total
Hydrologic Data Branch	16*	85**	15***	116
Inland Waters Branch-supported by the Division of Water Resources	47	2	25	74
River Basin Research Branch	20	11	0	31

* Includes two recorders operated during the open-water season only.

** 78 stations were read at irregular intervals.

*** 13 operated during open-water season only.

Fig. 6
Streamflow Gauging Stations Operated by the Branch or Maintained Co-operatively with the Federal Government



A system to use digitizing and computer facilities to convert the stage records, obtained from A-35 recorders, to discharge records was developed and adopted. The data from automatic recording stations are released to the Water Survey of Canada for inclusion in its annual publication "Surface Water Data - Ontario". Data from manual

stations and miscellaneous measurements are published in the Surface Water Series of Water Resources Bulletins. Bulletins 3-3 and 3-4 containing data for the periods October 1967 – December 1968, and January 1969 – December 1969, respectively, were published and Bulletin 3-5 covering 1970 is in the process of being assembled.

The Branch participated in a number of special studies or proceeded to obtain hydrometric data for particular studies. Examples of support projects are summarized below.

- Data on water use and streamflow were gathered and recorded as a contribution to the report “Water Pollution from the Uranium Mining Industries in Elliot Lake and Bancroft Areas”.
- In order to assess the potential for municipal water supplies, streamflow studies were undertaken at Ameliasburg, Stirling, Killaloe Station and Colborne.
- Flow patterns in the three channels of the Kaministiquia River at Thunder Bay were studied to support a water quality survey.
- Monitoring of flow in Honsburger Creek was initiated to permit assessment of any interference with streamflow that may result from a municipal well development.
- Baseflow recession and low flow frequency analyses for Patterson Creek and the Lynn River were completed in support of water use and management studies and flow data were synthesized for several locations in the Grand River basin for resource planning studies.
- Advice and assistance were extended to the Department of Lands and Forests in the choice and siting of flow measuring structures at Midhurst on a site which is being considered for the development of a fish hatchery. Assistance will also be given in the analysis of the data collected.

Northern Ontario Water Resources Studies

The collection of hydrologic data was continued in the Hudson Bay drainage basins. Eighty-seven streamflow measurements were made at 15 sites throughout the summer. Automatic water-level recorders were installed and operated at the 15 sites. Thirteen were operated during the summer season only and two for the full year. Under this program, the Water Survey of Canada operates 25 recording streamflow gauges and five lake level gauges on a shared-cost basis. The Branch requested and shared in the cost of construction of two new stations. These were on the Cat River at Wesleyan Lake in the Albany River Basin and on the Sachigo River downstream from Sachigo Lake in the Severn River Basin.

A bubbler-type of water-level recorder, utilizing desirable components from two separate commercial units was developed by branch staff. Seven of these recorders were installed on observation wells. A Stevens A-35 recorder was installed on another well and nineteen observation wells were measured manually. Six snow courses were in operation during the year.

Water Resources Bulletin 1-2, containing data collected in 1968 and 1969 was published. A bulletin with data collected in 1970 was under preparation.

RIVER BASIN RESEARCH BRANCH

The activities of the River Basin Research Branch were largely concentrated on scientific hydrologic studies in five representative river basins in southern Ontario but also included specialized studies such as soil analyses, special drilling projects, electric well logging and other geophysical methods in support of Branch and Division programs, and studies of ground-water inflow into Lake Ontario. The basin studies and the

inflow studies are related to the International Hydrological Decade.

Representative Basin Studies

The study of hydrologic and hydrogeologic phenomena in five drainage basins, representative of major geomorphologic regions in southern Ontario, continued. This program has been designed to improve interpretive skills through better understanding and methodology and as such has been accepted as a contribution to the program of the International Hydrological Decade.

Table 7 shows a summary of the hydrometric stations operated by the Branch in its five representative basins. In general, the number of hydrometric stations has remained relatively constant since 1969, as instrumentation was largely completed and long-term data collection was in progress.

Blue Springs Creek

Studies in the Blue Springs Creek basin were continued in co-operation with the University of Guelph. The university continued with its tri-monthly water quality sampling program at one automatic streamflow gauging station. The samples were analysed by the OWRC Laboratory.

Routine streamflow measurements continued with the carrying out of seven metering surveys. Data collection was also continued from the existing network of observation wells. The compilation of daily low static levels was updated to include the 1968-1969 water year.

Work progressed on the hydrogeologic mapping of the basin and on the analysis of pumping-test data.

Bowmanville, Soper and Wilmot Creeks

Routine streamflow measurements continued with the carrying out of 13 metering surveys at existing stations. In addition, 9 special surveys were under-

TABLE 7

SUMMARY OF HYDROMETRIC STATIONS OPERATED BY THE RIVER BASIN RESEARCH BRANCH IN REPRESENTATIVE BASINS

BASIN	METEOROLOGICAL STATIONS		SNOW COURSES	STREAMFLOW GAUGING STATIONS		OBSERVATION WELLS		SOIL MOISTURE STATIONS
	Main	Satellite		Recording	Manual	Recording	Manual	
Blue Springs Creek	—	—	—	—	6	5	11	—
Bowmanville, Soper & Wilmot Creeks	2	13	12	13	2	12	40	16
East & Middle Oakville Creeks	1	6	8	4	—	2	32	—
Venison Creek	1	3	—	2	1	4	3	—
Wilton Creek	2	6	—	1	2	4	11	—
TOTALS	6	28	20	20	11	27	105	16

taken to provide supplementary data and observe the stations during winter conditions and under high and low flow situations. Three temporary gauging sites were established along Soper Creek for measuring baseflow conditions to help determine ground-water flow conditions in a portion of the basin. An artificial control at one station was rebuilt and plans were finalized for the incorporation of a low-profile control in the proposed design for a new bridge on Bowmanville Creek.

After consultation with the Water Survey of Canada, a program of digitizing of streamflow charts was commenced. This technique allowed for the determination of average daily discharges from one station in the basin at a considerable saving of staff time. Office work was carried out to develop methods of hydrograph separation using recession factor analyses and streamflow chemistry for data from Wilmot Creek. Work continued on the development of

a physical model approach for determining the ground-water storage capacity in a part of the Soper Creek basin. A report entitled "Effects of Natural Stream Channel Changes on Streamflow Measurements", using data from some of the gauging stations, was completed and was in the process of being printed.

Data collection from all of the observation wells in the basin as well as general maintenance were continued. Geohydrologic studies continued with the analysis of pumping-test data for the determination of flow velocities in the unsaturated and saturated zones in the basin.

A total of nine snow surveys were carried out during the winter periods to observe snow depths and calculate snow-water equivalents. The snow survey data collected during the 1969-1970 winter season were tabulated. The results of the tabulation were made available to the Conservation Authorities Branch, Department of Energy and Re-

sources Management, for use in flood forecasting and to the federal Department of Energy, Mines and Resources for use in assessing lake levels. Ground-temperature recorders were operational during the winter periods at the two main meteorological stations. The Sacramento precipitation storage gauges were measured throughout the year on a regular basis. The assembly of precipitation data for preliminary statistical analyses and the evaluation of the rain gauge network were commenced. In co-operation with the federal Meteorological Branch and the federal Inland Waters Branch, a method of digitizing net radiometer charts was devised.

A review of the soil moisture program was initiated, with field surveys and inspections of the soil moisture network being carried out and the data from the 1968 and 1969 field seasons being plotted. As part of this evaluation, preliminary checks and error detection were performed on the 1969 field

season data. Nine soil moisture surveys were carried out during the year and the results were plotted. The design of a chart recording system to facilitate the collection of field data using the neutron meter was completed.

Graduate students from the Faculty of Forestry of the University of Toronto were conducted on a field trip through the basin to review hydrologic instrumentation and hydrogeologic features.

East and Middle Oakville Creeks

Thirteen streamflow metering surveys were carried out during the year. Following modifications to the artificial concrete control at one gauging station, the 120" weir plate was re-installed to allow for accurate low-flow measurements. Digitizing was carried out on the records for one streamflow gauging station.

All of the observation wells in the basin were serviced regularly. In conjunction with the taking of water-level measurements, water samples from all of the shallow wells in the network were obtained for chemical analyses. Office work continued on the analysing of geohydrologic data to determine a preliminary water balance for the basin. These studies included those to determine the ground-water flow systems and the geochemical cycle in the basin.

Nine snow surveys were conducted on the snow courses in the basin during the winter months. All of the data from the 1969-1970 snow season were tabulated and the data were made available to other interested government agencies. A report entitled "Snow Survey Report — East and Middle Oakville Creeks Drainage Basin, 1968-1969" was completed and was in the process of being printed.

Venison Creek

Eleven routine streamflow metering surveys were carried out. Work continued on a report outlining a pre-

liminary evaluation of the streamflow gauging network in the basin.

General maintenance work was carried out and data were collected from all of the observation wells.

Wilton Creek

Twelve streamflow metering surveys were carried out during the year. Data were also collected from the Sacramento precipitation storage gauge. The collection and compilation of data from all observation wells in the basin were continued.

Geophysical Investigations

Geophysical work included use of electrical resistivity, seismic, and gamma and electric logging equipment for scientific and water-supply development projects and the development of analogue models.

Geophysical studies were carried out in support of hydrogeologic investigations in the East and Middle Oakville creeks basin. The data obtained during an electrical resistivity survey previously conducted were reviewed and re-interpreted and further field work to obtain true resistivity values at selected sites was planned. It is anticipated that subsurface sand channels can be identified in order to prepare a water probability map for the basin. To support this project, a seismic program was carried out and 41 shot holes were used to obtain refraction records.

To assist in the interpretation of geologic sequences during test-drilling projects, gamma and electric logging was carried out in five wells for the Surveys and Projects Branch and in three wells for the Hydrologic Data Branch. In addition, six observation wells in the Oakville Creek basin were logged for studies under the International Field Year on the Great Lakes program.

Seismic surveys were carried out in the vicinities of Holtre and Frankford in support of ground-water surveys undertaken by the Surveys and Projects

Branch. Brief reports were prepared for both surveys and it is anticipated that a comprehensive report, using the seismic data from the Frankford survey, will be prepared to outline fully the scope of the seismic method in hydrogeologic investigations. An algorithm for the interpretation of seismic records was written and tested on the CALL/360 system. It is expected that computer programs will be useful in the future for the processing of seismic data.

A preliminary design of an analogue model of certain aspects of ground-water conditions in the Soper Creek basin was completed. The model consisted of a network of 150 resistors and 150 capacitors and simulated subsurface flow at a given depth. It is intended to carry out additional studies on the basic model to simulate other ground-water conditions in the basin.

Soils Laboratory Studies

In support of test-drilling projects and geologic investigations carried out by other branches of the Division, 58 soil samples were processed in the Branch's soil laboratory. Sieve analyses were undertaken on 15 samples and hydrometer analyses on 43 samples. The Surveys and Projects Branch submitted the majority of the samples.

In addition to the above-mentioned samples, 10 hydrometer analyses were carried out in support of the International Field Year on the Great Lakes drilling programs.

International Field Year on the Great Lakes

Hydrogeologic studies were continued in the Lake Ontario drainage basin as part of the Commission's contribution to the study of ground-water inflow to the lake under the IFYGL program. The approach is to make broad hydrogeologic interpretations over the whole basin and detailed studies in several significant areas. Because of the multi-discipline and multi-

agency involvement, much time was spent in planning and co-ordination efforts.

Forty Mile Creek

Water-level measurements were taken during ten surveys in the basin. The evaluation of ground-water data was continued with the installation of piezometer nests at four sites in the basin, using the Branch's drilling rig. In order to evaluate amounts of ground-water discharge from the Niagara Escarpment, 14 streams were gauged. This study will be continued using portable weirs. An abstract on the "Hydrogeology of the Forty Mile Creek Drainage Basin" was prepared for a paper to be presented at the Fourteenth Conference on Great Lakes Research.

Oakville Creek

To supplement the IFYGL program, the East and Middle Oakville creeks basin area was extended to include the total Oakville Creek basin. In order to supplement the existing observation-well network, six piezometer nests were installed under a test-drilling contract. Short-duration bail tests were conducted on those piezometers extending into the Queenston shale bedrock. To further supplement the well network, the installation of two piezometer nests was commenced, using the Branch's drill rig. The advent of inclement weather curtailed the completion of this program. Slug tests were performed on three of the original observation wells in the network to test the response of the lowest piezometers. Five water-level measurement surveys were carried out on the supplementary well network.

Remote Sensing

Measurements of air and water temperatures, ground-water levels and soil moistures were taken at selected sites in representative study areas within the Lake Ontario drainage basin to provide ground-truth data for two remote

sensing flights arranged by NASA (National Aeronautical and Space Administration) for the IFYGL program. A review of the photographs obtained during the first flight on July 6 was made to relate the ground-truth information collected. CARED, an agency of McMaster University, is co-ordinating Canadian participation in the NASA overflights. The Branch participated in discussion meetings held at McMaster University regarding infra-red remote sensing.

Branch personnel co-operated with representatives of the federal Inland Waters Branch by providing some ground-truth data for a special remote sensing program in the Scarborough Bluffs and Bowmanville areas. Branch staff were present on the aircraft during low altitude infra-red overflights of selected sections of the eastern portion of the Lake Ontario basin. These flights were designed to determine areas of major ground-water inflows into the lake.

General

Piezometric surface maps and bed-rock contour maps were prepared for selected study basins. The outlining of areas containing major overburden supplies of ground water was completed for the Lake Ontario drainage basin and compilation of the data from both the American and Canadian sides of the basin was started in preparation for publishing a surficial well yields map.

An International Workshop for the IFYGL program was attended at McMaster University. Staff members participated in discussions of the Terrestrial Water Balance Panel and presented an outline of the on-going study on ground-water inflow into Lake Ontario. The OWRC hosted a meeting of the Terrestrial Water Balance Panel at the OWRC Laboratory.

A meeting of the Ground Water Sub-Group was held with representatives from the federal Inland Waters

Branch and the United States Geological Survey to discuss progress on the IFYGL study. A field trip to one study basin was held to review basin instrumentation with members of the participating agencies. Discussions were also attended in Ottawa with staff of the Inland Waters Branch and the Geological Survey of Canada regarding the co-operative ground-water studies in the Lake Ontario basin.

SPECIAL DRILLING PROJECTS

Township of Wainfleet

Two observation wells were drilled with the Branch's drill rig in support of a study undertaken by the Hydrologic Data Branch.

Port Maitland

Three shallow holes were drilled near the ERCO plant in support of a water-sampling program undertaken by the Surveys and Projects Branch.

Water Well Management



St. Clair River

Three holes were drilled in the St. Clair River area to obtain overburden samples for mercury content analysis. In total, 40 samples were submitted to the OWRC Laboratory. A brief report was prepared outlining the location of and sampling procedures for the test holes and the analysis results obtained.

EDP Liaison

Liaison was maintained by the Division with the Systems and EDP Branch, Division of Administrative Services, and significant progress was achieved in several areas where electronic data processing is applicable.

Water Well Record System

The Hydrologic Data Branch continued with the processing of the waterwell record data. Approximately 123,000 records were coded and submitted to the Systems and EDP Branch for keypunching and computer storage. The retrieval program to print the future Ground Water Bulletins was finalized, eliminating the task of manual compilation. The principles of the Water Well Record System and its present and future electronic data processing operations were presented at the Seminar on Ground Water Data Processing, sponsored by the federal Inland Waters Branch.

Streamflow Data System

In order to alleviate the manual task of streamflow water-level chart interpolation and calculation of daily streamflow at OWRC stations, a federal program of digitizing and processing of these charts was used by the River Basin Research Branch and the Hydrologic Data Branch.

Five computer programs were made operational to carry out streamflow data analyses, curve fitting and data simulation for regional studies, representative basin studies and water man-

agement programs undertaken by the Division. The computing facilities available for these programs were those of the Department of Highways' Computer Centre (IBM 360/65) and the CALL/360 time-sharing terminal of the Systems and EDP Branch.

STORET System

The Water and Well Management Branch of the Division completed the coding of all terminal streams in the Lake Ontario basin for use in its water-taking permit program. Efforts were co-ordinated with those of the Division of Sanitary Engineering under the guidance of the STORET Committee.

Scientific Programs

Several additional computer programs were in use by the branches to aid in research studies and water resources surveys.

CALL/360 statistical package programs were used and one new program was developed by the River Basin Research Branch to analyse snow survey data and to derive statistical relationships between snowpack parameters.

Operation of Refraction Seismograph



Five computer programs were developed and set up on the CALL/360 terminal by the River Basin Research Branch to carry out interpretation and display of geophysical seismic refraction data collected by the Branch for ground-water surveys and research studies.

Four ground-water flow programs were under development, two of which were provided at a course at the University of Ottawa on the "Applications of Finite Elements to Ground Water Hydrology".

One previously-developed chemical program was in use on the CALL/360 terminal to manipulate and summarize chemical quality data as received from the OWRC Laboratory.

Seminars and Conferences

The following EDP seminars and conferences were attended by divisional staff: familiarization seminars for the IBM CALL/360 time-sharing terminal, a seminar on "Geocoding", sponsored by the Ontario Statistical Centre of the Department of Treasury and Economics, Seminar on Ground Water Data Processing, sponsored by the federal Inland Waters Branch, and the Canadian Data Processing Conference of the Canadian National Business Show.

Task Force on Streamflow Data Analysis

Nineteen meetings of the Task Force on Streamflow Data Analysis were held. This task force, consisting of members from each of the four branches, has been operational since 1969. During 1970, the discussions of the group concerned reviews and documentation of data correlation, flow simulation and baseflow analysis techniques.



Appendix

PAPERS AND ADDRESSES BY OWRC PERSONNEL

Industrial Wastes

Armstrong, T. D.

Pollution Control in the North, The Canadian Institute of Mining and Metallurgy, Kirkland Lake, February 1970.

D. P. Caplice

Disposal of Concentrated Liquid Wastes. The Metropolitan Toronto and Region Industrial Waste Disposal Symposium, January 1970.

D. P. Caplice

Progress on Industrial Pollution Control in Ontario. The Ontario Industrial Development Seminar, October 1970.

D. P. Caplice, K. H. Shikaze

Aspects of Waste Control in the Mining Industry. 13th Conference on Great Lakes Research, Buffalo, April 1970.

Fitz, L. W.

Mercury and Industrial Wastes Discharges into Eastern Lake Superior. The Eastern Lake Superior Fisherman's Association, Sault Ste. Marie, November 1970.

Gotts, R. M.

Safe Disposal of Hazardous Wastes. The Canadian Chemical and Process Equipment Exhibition. Chemical Industries Accident Prevention Association, Toronto, September 1970.

Gotts, R. M.

Treatment and Disposal of Oil and Oily Waste Waters in the Manufacturing Industry. The Second Lubrication Seminar — American Society of Lubrication Engineers, Toronto Section, March 1970.

Grosse, G.

Chemical Engineering in Water Pollution Control. Lakehead University, Chemical Engineering Technology, October 1970.

Hussain, R. W.

Industrial Wastes Program in Ontario. The Superintendents of Silverwood's of Ontario, March 1970.

Hussain, R. W.

The Functions of the OWRC. The London Chamber of Commerce, Environmental Committee, October 1970.

Luyt, J. D.

Ontario's Pollution Control Program and its Relation to the Metal Working Industry. Western Ontario Chapter, American Society for Metals, Windsor, February 1970.

Ramsay, I.

Water Pollution and Industrial Wastes. The Institute of Power Engineers, Thunder Bay Branch, March 1970.

Ramsay, I.

Water Pollution from the Forestry Industry. The Canadian Institute of Forestry, Northwestern Ontario, April 1970.

Ramsay, I.

Industrial Waste Abatement Programs in Northwestern Ontario. The Lakehead Anti-Pollution Committee, May 1970.

Ramsay, I.

Water Pollution Problems in the Mining Industry. The Chemical Institute of Canada, Lakehead Section, November 1970.

Ramsay, I.

Problems of Government — Federal, Provincial and Municipal Governmental Organization for Pollution Control. Extension Course, Lakehead University, November 1970.

Shikaze, K. H.

Mine Tailings Dam Construction in Ontario. Second Annual Meeting, Canadian Mineral Processors, Ottawa, January 1970.

Shikaze, K. H.

Waste Control in Pollution Enamelling Operations. The 10th Porcelain Enamel Seminar, Oakville, November 1970.

Stewart, R. C.

Water Conditions of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. The Canadian Pulp and Paper Association, Niagara Branch, October 1970.

Turner, E. W.

Environmental Problems Associated with Forest Products Industries. Canadian Institute of Forestry, Harrington, Quebec, September 1970.

Laboratories

Berg, O. W.

Identification and Quantitation of Polychlorinated Biphenols by Catalytic Dechlorination. Second Eastern Seminar of Pesticides Residue Analysis, Ottawa, May 1970.

Osmond, D. S.

The Biological Evaluation of Water Quality. Joint meeting of the Chemical Institute of Canada and the American Chemical Society, Toronto, May 1970.

Schenk, C. F.

Water Pollution and its Control in Ontario. The Annual Convention of the Ontario Hospital Association, Toronto, October 1970.

Schenk, C. F.

Cottagers and Water Pollution. The first Annual Conference of the Ontario Branch of the Canadian Institute on Pollution Control, Toronto, April 1970.

Schenk, C. F.

Status of Aquatic Pollution Control in Ontario. The Annual Meeting of the Canadian Society of Wildlife and Fishery Biologists, Ottawa, January 1970.

- Research**
- Black, S. A.
Water — The Lifeblood of your Farm. United Co-operatives of Ontario, Showcase '70, London, January 1970.
- Black, S. A.
Phosphorus Removal by Lime Addition to a Conventional Activated Sludge Plant. Short Course in Water Quality Control, University of Massachusetts, March 1970.
- Black, S. A.
Farm Animal Wastes & Water Pollution in Ontario. Western Ontario Veterinary Medical Association Annual Meeting, Centralia, May 1970.
- Black, S. A.
Agriculture and Water Pollution in Ontario. Canadian Society of Agricultural Engineers Conference, Ottawa, July 1970.
- Black, S. A.
New Lime Treatment of Sewage to Remove Phosphates. Canadian Lime Institute Annual Meeting, Winnipeg, September 1970.
- Black, S. A., Mills, G. H.
Phosphorus Removal by Lime Addition to a Conventional Activated Sludge Plant. Solutions for Pollution in an Urban Environment Conference, Canadian Society for Chemical Engineers, Chemical Institute of Canada, Montreal, November 1970.
- Boyko, B. I., Rupke, J. W. G.
Aerated Lagoons in Ontario — Design and Performance Considerations. Second International Symposium for Waste Treatment Lagoons, Kansas City, Missouri, June 1970.
- Christie, A. E.
Phytoplankton Studies in the Bay of Quinte. Phycological Section, Canadian Botanical Association, Laval University, Quebec City, June 1970.
- Dart, F. J., Foley, P. D.
Sodium Silicate to Prevent Iron Deposition in the Distribution Systems. AWWA 90th Annual Conference, Washington, D.C. June 1970.
- Dart, F. J., Foley, P. D.
Preventing Iron Deposition with Sodium Silicate. Journal American Water Works Association, Vol. 62, No. 10, October 1970.
- Sanitary Engineering**
- Palmer, M. D., Izatt, J. B.
Dispersion prediction from current meters. Proceedings American Society of Civil Engineers, Hydraulics Division. Vol. 96, No. HY8, August 1970.
- Palmer, M. D., Izatt, J. B.
Lakeshore two-dimensional dispersion. Proceedings Thirteenth Conference on Great Lakes Research, Buffalo, New York, April 1970.
- Palmer, M. D.
Submersible recording current and water quality meters. Proceedings 17th Ontario Industrial Waste Conference, Niagara Falls, June 1970 and Water and Sewage Works, Reference No. 1970.
- Palmer, M. D., Izatt, J. B.
Water quality modelling with submersible recording water quality and current meters. Proceedings, National Symposium on Data and Instrumentation for Water Quality Management, Madison, Wisconsin, July 1970.
- Palmer, M. D., Izatt, J. B.
Determination of Some Chemical and Physical Relationships from Recording Meters. Journal of Water Research, Vol. IV, No. 12, December 1970.
- Redekopp, A. B.
Training of Water Works Personnel in Ontario. American Water Works Association National Conference, Panel Discussion, Washington, June 1970.
- Salbach, S. E.
Water Pollution Control in Ontario. Proceedings, Ottawa River Conference, Pollution Probe, Ottawa, June 1970.
- Salbach, S. E.
Water Quality Management in Ontario. 1970 Canadian Plant Engineering Conference, Montreal, May 1970.
- Terry, R. D., Salbach, S. E.
Land Use-Nutrient Level Relationships on Two Southern Ontario Watersheds. Proceedings, Fifth Canadian Symposium on Water Pollution Research, Volume 5, Waterloo, February 1970.
- Water Resources**
- Bryck, L. G.
Interpretation of Ontario Water Well Regulation 46-49. Canadian Water Well Contractors Association Annual Convention, Kitchener, June 1970.
- Dennis, P.
Permits to Take Water and Records of Water. Ontario Golf Superintendents Association, Oshawa, April 1970.
- Hore, R. C.
Research Activities on Representative Basins in Ontario. Toronto Hydrology Group Meeting No. 39, OWRC Laboratory, December 1970.
- Jeffs, D. N., Viirland, J.
Special Cases of Water Supply Interference Caused by Urban Development near Toronto, Ontario, Canada. American Water Resources Association Bulletin, Vol. 6, No. 5, October 1970.



